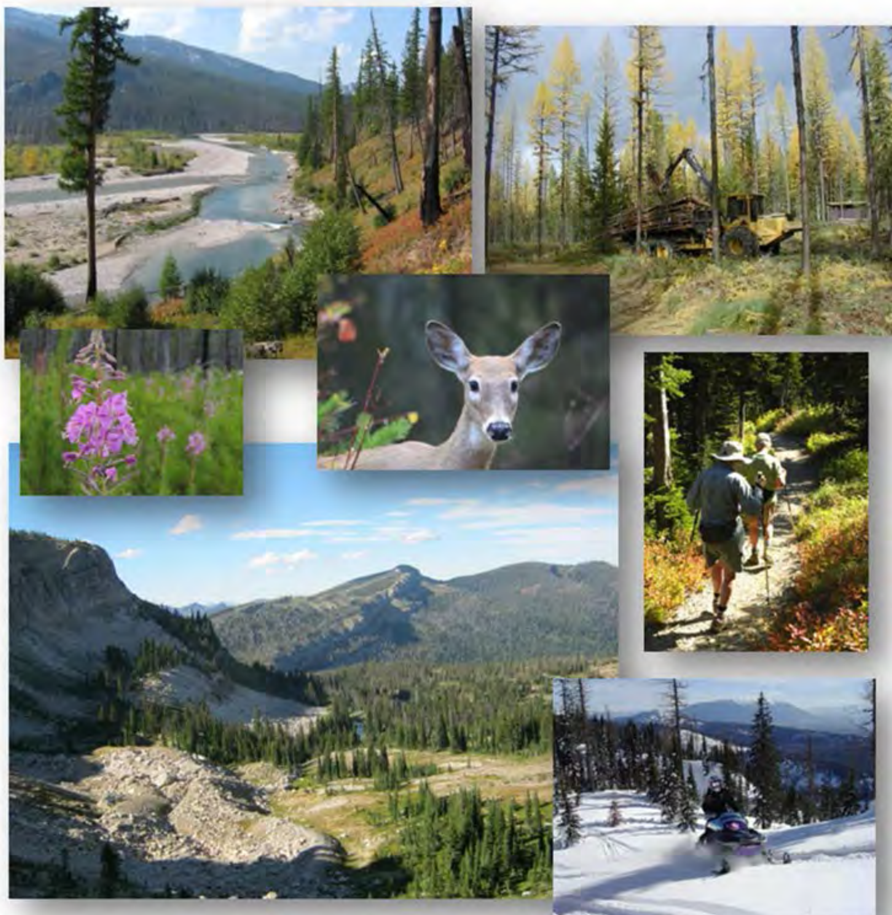
United States Department of Agriculture

Draft Environmental Impact Statement
Volume 1: Revised Forest Plan
Flathead National Forest



Forest Service May 2016

"…the greatest good for the greatest number in the long run." –Gifford Pinchot, 1st Chief of the Forest Service, 1905

Flathead National Forest photo captions (clockwise from upper left):

- South Fork of the Flathead River, Spotted Bear Ranger District
- Forwarder working on the Paint Emery Resource Mgt. Project, Hungry Horse –Glacier View Ranger District
- Two hikers
- Snowmobile
- View taken on the way to Pentagon Cabin in the Bob Marshall Wilderness (photo by Peter Borgesen)
- Fireweed
- Whitetail deer (photo by John Littlefield)

Volume 1: Draft Environmental Impact Statement for the Revised Forest Plan for the Flathead National Forest

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Abstract: This is volume 1 of the draft environmental impact statement (DEIS) document containing analysis of 4 alternatives developed for programmatic management of the 2.4 million acres administered by the Flathead National Forest.

Comments: Comments on this DEIS must be received or postmarked within 120 days of the Environmental Protection Agency's publication of the Notice of Availability in the Federal Register. It is important that reviewers provide their comments at such times and in such a way that they are useful to the Agency's preparation of the final environmental impact statement. Therefore, comments should be provided prior to the close of the comment period and should clearly articulate the reviewer's concerns and contentions. Comments received in response to this solicitation, including names and addresses of those who comment, will be part of the public record and can be accessed here: https://cara.ecosystem-management.org/Public/ReadingRoom?project=46286. Comments submitted anonymously will be accepted and considered; however, anonymous comments will not provide the respondent with standing to participate in subsequent administrative or judicial reviews.

The decision to approve the revised forest plan for the Flathead National Forest and the amendments for the Helena, Lewis and Clark, Kootenai, and Lolo National Forests will be subject to the objection process identified in 36 CFR Part 219 Subpart B (219.50 to 219.62). Only those individuals and entities who have submitted substantive formal comments related to the Flathead National Forest plan revision and the four amendments during the opportunities provided for public comment, will be eligible to file an objection (36 Code of Federal Regulations (CFR) 219.53(a)).

Send comments to: Flathead National Forest Supervisor's Office, Attn: Forest Plan Revision, 650 Wolfpack Way, Kalispell, Montana 59901. Electronic comments may be sent to http://www.fs.usda.gov/project/?project=46286.

Table of Contents

REFER TO volume 2 for the remainder of the chapter 3: Affected Environment and Environmental Consequences. The sections of chapter 3 in volume 2 are:

- Human uses, benefits, and designations of the Forest;
- Production of natural resources; and
- Economic, social and cultural environment.

List of Tables

List of Figures

NOTE: The figures listed below are found in the text of the document. When figures are referenced that are preceded by 1, e.g. figure 1-01, it is within appendix 1 of this draft EIS, and if preceded by B, e.g. B-01, it is in appendix B of the draft forest plan. Most of the figures in appendix 1 and appendix B are on the cd that accompanies this draft EIS. Figures 1-01 thru 1-04, forestwide maps of management areas by alternative, are located in appendix 1 of volume 2.

Summary of Volumes 1 and 2

The U.S. Forest Service has prepared this draft environmental impact statement (DEIS) that describes and analyzes in detail four alternatives for managing the land and resources of the Flathead National Forest (hereinafter referred to as the “Forest”). The DEIS describes the affected environment and discloses environmental effects of the alternatives.

Proposed Action

The Flathead National Forest proposes to revise its Land and Resource Management Plan (1986), referred to as the “forest plan,” in compliance with the 2012 planning rule (36 CFR § 219.17(3)(b)(1)). The area affected by the proposal includes about 2.4 million acres of public land, shown in figure 1. The Forest Service is concurrently amending the forest plans of the Helena, Kootenai, Lewis and Clark, and Lolo National Forests (referred to as “amendment forests”) to incorporate relevant direction from the Northern Continental Divide Ecosystem (NCDE) Grizzly Bear Conservation Strategy (GBCS). Refer to volume 3 of the DEIS for the evaluation of effects of the amendments. The Flathead is proposing to incorporate the relevant portions of the NCDE GBCS as part of its plan revision process.

Purpose and Need

The purpose of the action is to revise the 1986 forest plan for the Flathead. The revised forest plan would guide natural resource management activities on the Forest and address changed conditions and direction that have occurred since the original plan, while meeting the requirements of the 2012 planning rule. Findings from the Assessment of the Flathead National Forest (2014; hereinafter “Assessment”), changes in conditions and demands since the 1986 forest plan, and public concerns to date highlighted several areas where changes are needed to the current plan to necessitate a plan revision.

To develop a revised forest plan, the management direction in the current plan and its amendments is reviewed. Effective management direction from the current plan may be retained or it may be modified, or augmented, by incorporating relevant science or direction from other regulatory documents. The 2012 planning rule requirements also mandate that new management direction be developed.

Public Involvement

Public participation in the forest plan revision process began during the development of the Assessment. To facilitate local participation, the Forest contracted with the U.S. Institute for Environmental Conflict Resolution in 2012 to develop a collaborative stakeholder engagement process. The Institute interviewed Forest Service employees and a representative group of key stakeholders to determine their willingness to engage in a collaborative process convened by a neutral, third party. The Meridian Institute was selected to serve in that capacity and facilitated numerous topical work groups, an interagency group, and meetings to bring together all work groups and interested citizens. As part of the public involvement process, the Forest Service led field trips and held open house sessions to discuss existing information and trends related to a variety of conditions found on the forest. From October 2013 through June 2014, the Flathead hosted monthly meetings with the intent to collaboratively develop plan components that the Forest could consider in the development of a proposed action. The dialogue and recommendations from this public involvement process was used to help develop the proposed action.

The notice of intent on the proposed action was published in the Federal Register on March 6, 2015. The notice of intent asked for public comment on the proposal for a 60-day period (until May 5, 2015). The comment period was subsequently extended by 10 days (until May 15, 2015). In addition, as part of the public involvement process, the agency held seven open houses to provide opportunities to better understand the proposed action so that meaningful public comments could be provided by the end of the scoping period.

Significant Issues

Issues serve to highlight effects or unintended consequences that may occur from the proposed action or alternatives. The Forest Service separated the issues identified during scoping into two groups: significant and non-significant issues. Significant issues were defined as those directly or indirectly caused by implementing the proposed action, involve potentially significant effects, and could be meaningfully and reasonably evaluated and addressed within the programmatic scope of a Forest Plan[1]. Alternatives were developed around those significant issues that involved unresolved conflicts concerning alternative uses of available resources

The Forest Service identified the following significant issues during scoping that drove alternative development:

- Vegetation management, timber production, and fire and fuels management
- Wildlife Habitat
- Access and recreation
- Recommended wilderness

Alternatives

These significant issues led the agency to develop four alternatives:

Alternative A is the no-action alternative. This alternative is the 1986 forest plan, as amended to date, and accounts for current laws, regulations, and biological opinions. New information, inventories, and technologies were used to evaluate this alternative. Eligible wild and scenic rivers identified in the revision process are included in this alternative. Output levels were recalculated for this alternative based on these new sources of information and amended direction. The no-action alternative retains the 1986 Forest Plan goals and objectives, standards and guidelines, and MA prescriptions, as amended. This alternative serves as the baseline for comparison with the action alternatives. The no-action alternative manages approximately 4 percent of the Forest as recommended wilderness (MA1b), 17 percent as backcountry (MA5), and 33 percent as general forest (MA6). Twenty-two percent of the Forest would be suitable for timber production.

Alternative B is the modified proposed action for the draft revised forest plan (the “ draft forest plan”) that was developed in response to public involvement efforts that began in 2013 and was subsequently modified based upon comments received during scoping. This alternative emphasizes moving towards desired conditions and while providing a balance of ecological, social, and economic sustainability. Alternative B would manage approximately 8 percent of the Forest as recommended

1 Some issues are best resolved at finer scales, where the site specific details of a specific action and resources it affects can be meaningfully evaluated and weighed (requiring subsequent National Environmental Policy Act (NEPA). Conversely, some issues have already been considered through broader programmatic NEPA (e.g. the Northern Rockies Lynx Management Direction). In these cases, the issues focus on evaluating the effects unique to and commensurate with the decisions being considered here.

wilderness (MA1b), 13 percent as backcountry (MA5), and 30 percent as general forest (MA6). Twenty-one percent of the Forest would be suitable for timber production.

Alternative C emphasizes wilderness values and protection of backcountry non-motorized values while moving towards desired conditions. There is an increased emphasis on wildlife habitat security and fish habitat. Achieving desired conditions would rely more on natural disturbance processes, such as unplanned wildfire ignitions for multiple objectives, as well as prescribed burning. Mechanical treatments (e.g., timber harvest, fuels reduction) also occur in order to move towards social, economic and ecological sustainability, but acres suitable for timber productions would be lower than alternatives A, B, and D. Alternative C would have more opportunities for backcountry and non-motorized recreation as this alternative has backcountry management areas and more acres recommended as wilderness (MA5 6 percent, MA 1b 21 percent) than any other alternative. About 25 percent would be allocated to general forest (MA6). Thirteen percent of the Forest would be suitable for timber production.

Alternative D emphasizes a more active management approach to achieve or move towards desired future conditions and social, economic, and ecological sustainability. Greater emphasis is placed on the use of timber harvest and other mechanical means to achieve desired conditions. This alternative has the most acres suitable for timber production and available for timber harvest, as well as for motorized access. Twenty-one percent of the Forest would be suitable for timber production with 25 percent allocated to MA6b and MA6c (general forest). No additional acres are allocated to recommended wilderness and IRAs would be allocated to backcountry (MA5 – less than 20 percent of the Forest) or to MA 6a (5 percent).

Comparison of Alternatives

The following table compares alternatives by a summary of management area allocations. Table 1 compares alternatives by management area allocation and indicates only one management area designation for each acre based upon an established hierarchy. Lands with dual or multiple management area designations are managed in accordance with applicable plan direction.

In instances where management area allocations over-lap, e.g. an area that is MA1b recommended wilderness may also be 4a, a research natural area, then the acres were calculated based upon the following hierarchy:

1. Designated Wilderness (MA 1a)
2. Designated Wild and Scenic Rivers (MA 2a)
3. Recommended Wilderness (MA 1b)
4. Research Natural Areas (MA 4a)
5. Eligible Wild and Scenic Rivers (MA 2b)
6. Experimental and Demonstration Forests (MA 4b)
7. Special Areas (MA 3)

For a table that displays the actual acres, versus the single designation based upon established hierarchy, refer to table 5 in chapter 2.

Table 1. Comparison of alternatives by management area acres[a] and percent allocation (single designation based upon established hierarchy)

Management Area	Alt A acres[b] (percent)	Alt B acres (percent)	Alt C acres (percent)	Alt D acres (percent)
1a Designated Wilderness	1,072,040 (45%)	1,072,040 (45%)	1,072,040 (45%)	1,072,040 (45%)
1b Recommended wilderness	98,388 (4%)	187,741 (8%)	506,919 (21%)	0
2a Designated wild and scenic rivers	17,605 (1%)	17,605 (1%)	17,605 (1%)	17,605 (1%)
2b Eligible wild and scenic rivers	0[c]	19,259 (1%)	15,701 (1%)	31,615 (1%)
3a Administrative areas	1,919 (<1%)	435 (<1%)	435 (<1%)	435 (<1%)
3b Special areas	226	1,579 (<1%)	1,579 (<1%)	14,787 (1%)
4a Research natural areas	9870 (<1%)	7,820 (<1%)	2,423 (<1%)	8,544 (<1%)
4b Experimental and demonstration forests	6,602 (<1%)[d]	11,544 (<1%)	11,544 (<1%)	11,544 (<1%)
5a Backcountry non-motorized year-round	--	156,104 (7%)	61,052 (3%)	291,071 (12%)
5b Backcountry motorized year-round, wheeled vehicle use only on designated routes/areas	--	50,374 (2%)	441 (<1%)	50,365 (2%)
5c Backcountry: motorized over-snow vehicle use	--	99,196 (4%)	73,426 (3%)	117,650 (5%)
5d Backcountry: wheeled motorized vehicle use only on designated routes/areas	--	9,855 (<1%)	0	9,855 (<1%)
5a-d Backcountry **Total**	401,018[e] (17%)	315,529 (13%)	134,919 (6%)	468,942 (20%)
6a General forest low	74,381 (3%)	119,944 (5%)	214,603 (9%)	116,657 (5%)
6b General forest medium	208,304 (9%)	437,617 (18%)	258,056 (11%)	292,939 (12%)
6c General forest high	496,898 (21%)	169,080 (7%)	125,946 (5%)	297,095 (12%)
6a-c General forest **Total**	779,583 (33%)	726,641 (30%)	598,605 (25%)	706,691 (30%)
7 Focused recreation areas	5,557 (<1%)[f]	32,615 (1%)	31,037 (1%)	60,903 (3%)
Total **Forest Acres**	2,392,807	2,392,807	2,392,807	2,392,807

a. Acres and percentage from GIS dataset. The official acres for NFS lands and wilderness areas can be found in the land area report, http://www.fs.fed.us/land/staff/lar-index.shtml .

b. Alternative A, the no-action alternative, is included even though it does not use the management areas shown in the draft forest plan. See table 3 for a crosswalk of the 1986 plan management areas to those used in the draft forest plan and the action alternatives.

c. Acres of eligible wild and scenic rivers in the existing plan are the same as in the action alternatives (see Table 5). However, they were not assigned a MA in the existing 1986 forest plan, and were not mapped for the DEIS.

d. Miller Creek Demonstration Forest (4942 acres) was not assigned a management area in the existing 1986 plan.

e. The existing plan does not differentiate backcountry areas like the action alternatives; thus all backcountry acres are combined.

f. There is no MA in the existing 1986 forest plan equivalent to Focused Recreation Areas. These acres are the Round Meadow and Essex cross country ski areas and the mapped developed recreation sites.

Chapter 1. Purpose and Need for Action

1.1 Introduction

The Forest Service has prepared this draft environmental impact statement (DEIS) in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. This DEIS discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. The document is organized as follows:

Volume 1: DEIS for the Revised Forest Plan for the Flathead National Forest

Chapter 1. Purpose of and Need for Action outlines the purpose and need for forest plan revision, the plan area, the scope of the analysis, and decisions to be made.

Chapter 2. Alternatives, including the proposed action, describes the public involvement process, identifies key issues used for alternative development, and describes the alternatives. Alternatives considered but eliminated from detailed study are listed. A summary comparison of alternatives is provided at the end of the chapter.

Chapter 3. Affected Environment and Environmental Consequences describes current conditions on the Flathead National Forest and the environmental consequences of implementing each alternative. Physical and biological section of chapter 3 is in volume 1.

Back matter: index.

Volume 2: DEIS for the Revised Forest Plan for the Flathead National Forest (continued)

Chapter 3 (continued). Affected Environment and Environmental Consequences, sections on human uses, benefits, and designations of the Forest, production of natural resources, and economic, social and cultural environment.

Back matter: index, list of literature cited, a glossary of terms, and appendices:

- Appendix 1—Maps (majority of maps are in the cd accompanying the DEIS)
- Appendix 2—Vegetation and Timber Analysis Process
- Appendix 3—Modeled Wildlife Habitat Assessment
- Appendix 4—Recommended Wilderness Analysis Process
- Appendix 5—Wild and Scenic River Eligibility Study Process

Volume 3: DEIS for the Forest Plan Amendments to incorporate relevant direction from the NCDE Grizzly Bear Conservation Strategy for the Helena, Kootenai, Lewis and Clark, and Lolo National Forests

Chapter 4. Purpose of and Need for Action–Forest Plan Amendments includes the history of grizzly bear habitat conservation efforts, and outlines the purpose of and need for the forest plan amendments, and decisions to be made.

Chapter 5. Alternatives Considered for the Forest Plan Amendments describes the public involvement process, identifies key issues used for alternative development, and describes the alternatives. Alternatives considered but eliminated from detailed study are listed. A summary comparison of alternatives is provided at the end of the chapter.

Chapter 6. Affected Environment and Environmental Consequences for the Forest Plan Amendments describes current conditions on the Helena, Kootenai, Lewis and Clark, and Lolo National Forests and the environmental consequences of implementing each alternative.

Chapter 7. A list of preparers of the DEIS, and a list of to whom copies of the DEIS were sent to.

Back matter: index, and literature cited and appendices:

- **Appendix 6—Draft Forest Plan Amendments** to incorporate relevant direction from the NCDE Grizzly Bear Conservation Strategy for the Helena, Kootenai, Lewis and Clark, and Lolo National Forests. Includes a glossary.
- Appendix 7—Alternative Comparison by National Forest

The **Draft Revised Forest Plan for the Flathead National Forest** ("draft forest plan") is a separate, accompanying document and includes the following appendices:

- Appendix A—Monitoring Program
- Appendix B—Maps
- Appendix C—Potential Management Approaches and Possible Actions
- Appendix D—Biophysical Settings and Species Lists
- Appendix E—Watershed Condition Framework and Priority/Conservation Watershed Network
- Appendix F—Northern Rockies Lynx Management Direction Record of Decision
- Appendix G—Crosswalk (guide to locating plan components, includes drivers and stressors related plan components)

1.2 Proposed Action

The Forest Service proposes to revise the Land and Resource Management Plan (hereinafter referred to as the "draft forest plan") in compliance with the National Forest System land management planning rule (USDA 2012; 36 CFR § 219), hereinafter referred to as the "2012 planning rule." The area covered under this revision is shown in figure 1. The Forest Service is concurrently amending the forest plans of the Helena, Kootenai, Lewis and Clark, and Lolo National Forests (also referred to as "amendment forests") to incorporate relevant direction from the Northern Continental Divide Ecosystem (NCDE) Grizzly Bear Conservation Strategy (GBCS). Refer to volume 3 of the DEIS for the amendment. The Flathead is proposing to incorporate the relevant portions of the NCDE GBCS as part of its plan revision process.

The need for the proposed action is twofold: 1) to address significant changes that have occurred in conditions and demands since the Flathead's 1986 Forest Plan and 2) to ensure the adequacy of regulatory mechanisms regarding habitat protection across the national forests in the NCDE in support of the de-listing of the grizzly bear.

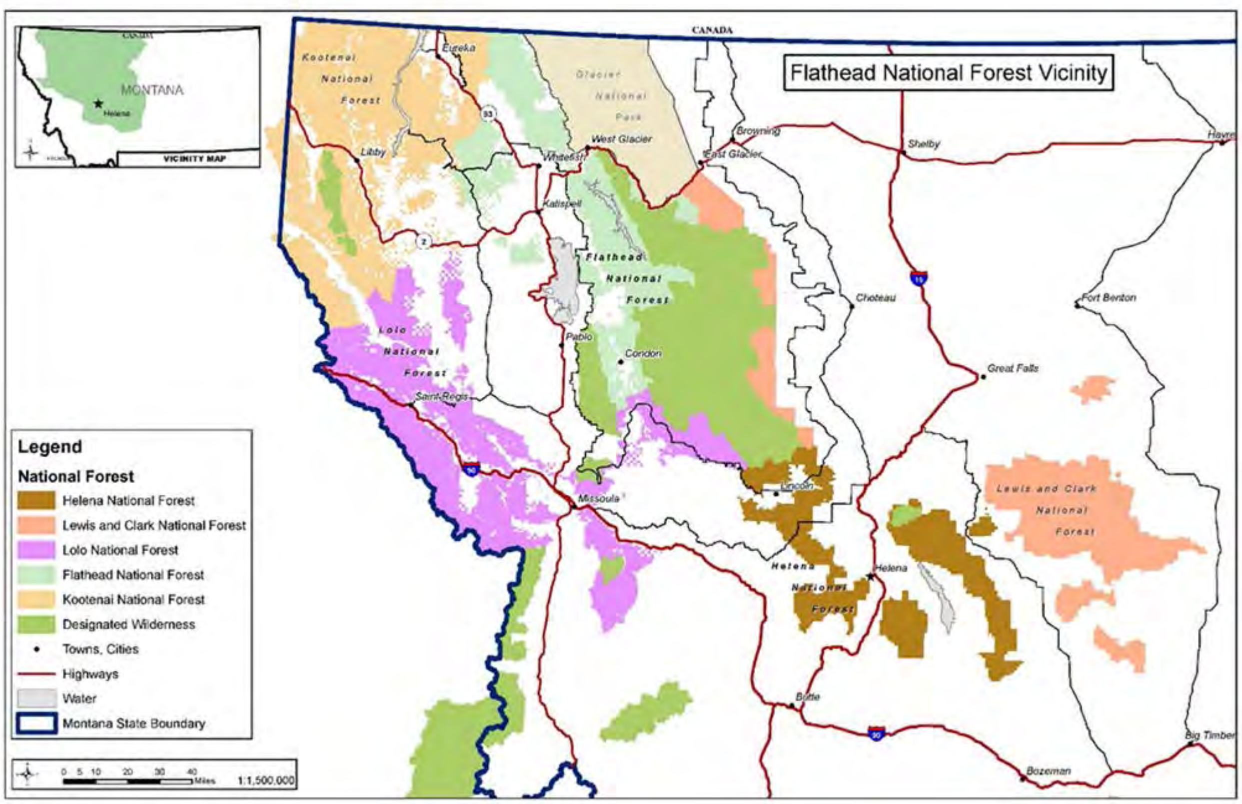
On March 6, 2015 the Flathead National Forest released the proposed action with a notice of intent to prepare an environmental impact statement in the Federal Register. The notice of intent initiated the scoping process, which guides the development of the environmental impact statement. The Forest received over 20,000 public comments on the proposed action during the 70-day comment period that ended May 15, 2015. The Flathead National Forest plan revision team reviewed all the comments and the responsible official identified the significant issues that were used to frame alternatives for the draft forest plan. The planning team used these issues and public comments to refine the proposed action and build alternatives. Modifications to the proposed action are discussed in the description of alternative B, as well as in the introduction to the draft forest plan.

Additional documentation, including more detailed analyses of project area resources, public involvement information, and other documents used for developing alternatives and background for the resource specialists' analysis may be found in the planning record located at the Flathead National Forest Supervisor's Office.

1.3 The Planning Area

The Flathead National Forest, located in the northern Rocky Mountains amidst the mountains and valleys of western Montana, includes approximately 2.4 million acres of public land in portions of Flathead, Lake, Lewis and Clark, Lincoln, Missoula, and Powell counties. The Forest has five ranger districts: Swan Lake, Hungry Horse, Glacier View, Tally Lake, and Spotted Bear. The Forest Supervisor's office is located in Kalispell, Montana. Figure 1 shows the Flathead and surrounding vicinity lands.

Figure 1. Flathead National Forest and vicinity



Encircled by the Kootenai, Lewis and Clark, and Lolo National Forests, Glacier National Park, and Canada, the Flathead National Forest is the true heart of the northern Rocky Mountain ecosystem.

Large designated wilderness areas, such as the Bob Marshall Wilderness Complex and the Mission Mountains Wilderness, in concert with other special areas such as wild and scenic river systems, the Jewel Basin Hiking Area, and other undeveloped backcountry areas, provide habitat strongholds for a host of plant and animal species. The NCDE covers most of the Flathead National Forest.

The Flathead National Forest is divided into six geographic areas, which provide a means for describing conditions and trends at a more local scale if appropriate. Geographic areas are ecological areas that are synonymous with certain basins and watersheds. Table 2 displays the acres of the Forest by geographic area and figure 2 shows the location of the geographic areas.

Table 2. Acres within the six geographic areas (GAs) on the Forest

GA	Total Acres (all ownerships)	Total Acres (Forest)	Percent of GA in NFS Lands
North Fork	389,682	320,044	82%
Middle Fork	375,354	370,156	99%
Hungry Horse	331,752	286,234	86%
South Fork	790,585	789,074	100%
Swan Valley	533,139	364,440	68%
Salish Mountains	836,482	262,859	31%
TOTAL ACRES	3,256,994	2,392,807	73%

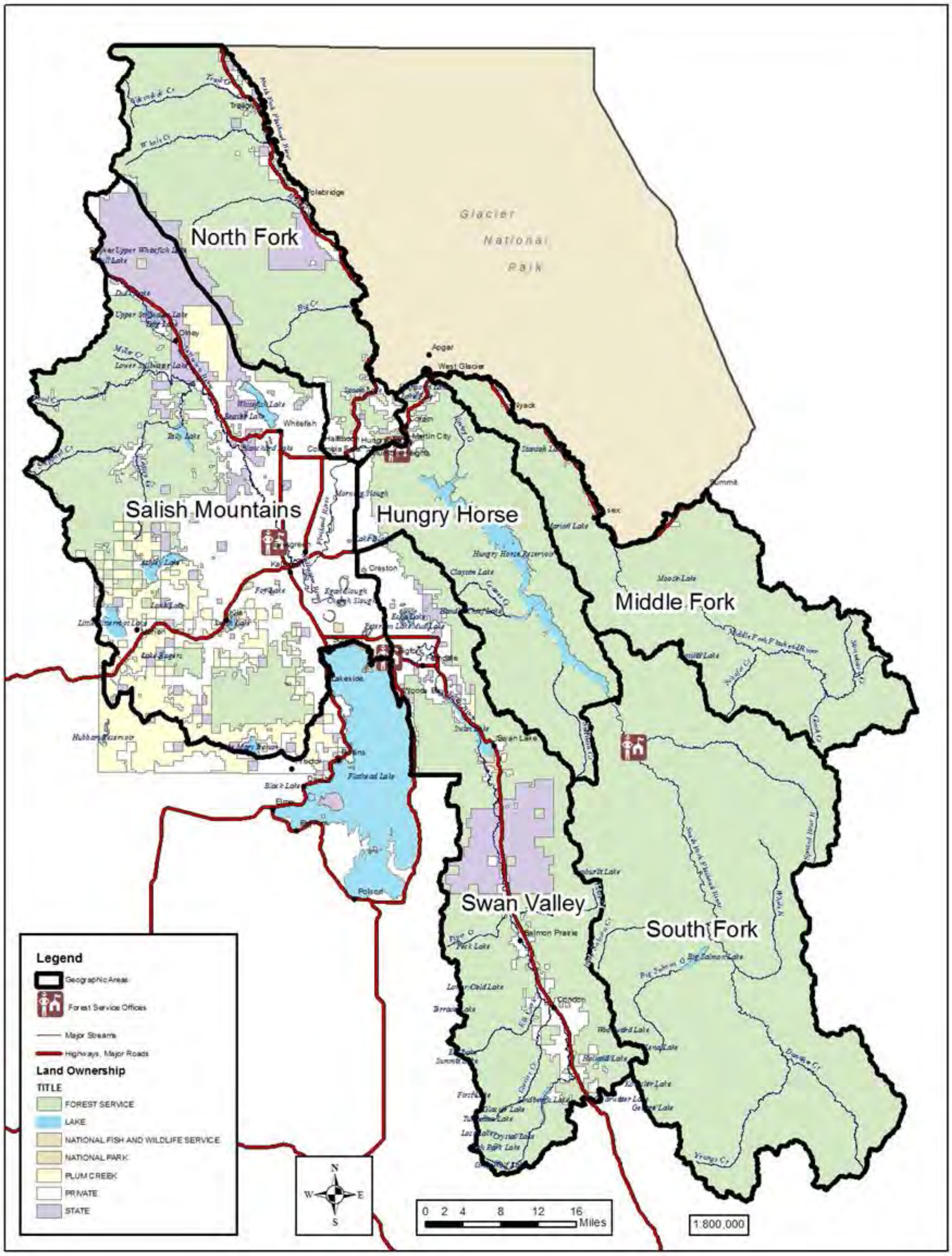


Figure 2. The six geographic areas on the Flathead National Forest

1.4 Purpose and Need for Action

The requirements of the 2012 planning rule, findings from the Assessment, changes in conditions and demands since the 1986 forest plan, and public concerns to date highlighted several areas where changes are needed to the current plan to necessitate a plan revision.

To develop a proposed action that makes changes to a forest plan, the management direction in the current plan and its amendments is reviewed. Effective management direction from the current plan may be retained, or it may be modified or augmented by incorporating relevant new scientific information or direction from other regulatory documents. The 2012 planning rule requirements also mandate that new management direction be developed to address sustainability. This section discusses in overview how needs for change identified in the current plan and its amendments, specifically in areas of public concern, were addressed during the development of the proposed action.

1.4.1 **2012 planning rule requirements**

The 2012 planning rule supports ecological, social, and economic sustainability as a goal for management of NFS lands. To address this requirement, new management direction was developed in several areas:

- For ecological sustainability, management direction is proposed to address ecosystem diversity and key ecosystem characteristics and their integrity, especially in light of changing climates, changes in fuels and vegetation management strategies, and future environments. Forest plan components are also needed that focus on maintaining or restoring vegetation and ecosystem resilience to provide for species diversity (including threatened and endangered species, species of conservation concern and species of interest for fishing, hunting, trapping, viewing, and subsistence; see appendix D of the draft revised forest plan for lists of these species).
- Comprehensive management direction to address access and sustainable recreation is proposed. This direction considers the suitability of certain areas for particular uses, recreational opportunities, and all aspects of motorized and non-motorized travel to provide for the management of existing and anticipated uses as well as resource protection needs.
- The role of timber harvest in meeting ecosystem management and social and economic objectives has changed since the Flathead's 1986 Forest Plan was developed. The 2012 Planning Rule requires the Forest to undertake a process to identify lands within the plan area suitable for timber production. The draft revised forest plan presents new plan components for lands suitable for timber production and for lands where timber harvest is appropriate for purposes other than timber production (e.g., removal of hazard trees in campgrounds). These plan components are intended to facilitate an active vegetation management program of work to meet ecosystem and socioeconomic objectives.
- The planning rule requires land management plans to provide information regarding possible actions that may occur on the plan area during the life of the plan, including the planned timber sale program; timber harvesting levels; and the proportion of probable methods of forest vegetation management practices expected to be used (16 U.S.C. 1604(e)(2) and (f)(2)). The plan revision addresses this requirement through the designation of management areas, objectives reflecting anticipated budget levels, and disclosure of possible management actions (see appendix C of the draft forest plan).
- Proposed management direction provides people and communities with a range of social and economic benefits for present and future generations. The benefit to people (i.e., the goods and

services provided) are the ecosystem services from the ecosystem. The Forest's key ecosystem services, as discussed and identified in the Assessment, are: carbon sequestration and climate regulation; forest products such as wood products and huckleberries; water quality and quantity and flood control; clean air; outdoor recreation; scenery; fish and wildlife, i.e. habitat for these species; cultural/heritage values, inspiration, spiritual values and solitude; hunting, trapping, fishing, and wildlife viewing; and research and education.

- The identification and evaluation of lands that may be suitable for inclusion on the National Wilderness Preservation System and eligible rivers and streams for inclusion into the National Wild and Scenic Rivers System. Outcomes from the wilderness and eligible rivers evaluations may result in the need for new or draft forest plan components.

Plan components developed for ecosystem integrity and ecosystem diversity are expected to provide for ecological conditions necessary to maintain the persistence or contribute to the recovery of native species within the plan area, including at-risk species identified in the assessment. At-risk species for planning are threatened, endangered, proposed, and candidate species designated by the U.S. Fish and Wildlife Service and species of conservation concern that are designated by the Regional Forester. Threatened, endangered, proposed, and candidate species native to the Forest include the grizzly bear (*Ursus arctos horribilis*), Canada lynx (*Lynx canadensis*), bull trout (*Salvelinus confluentus*), water Howellia (*Howellia aquatilis),* meltwater stonefly *(Lednia tumana),* Spalding's catchfly (*Silene spaldingii)* and whitebark pine (*Pinus albicaulis*).

1.4.2 Grizzly bear habitat management

Under the Endangered Species Act of 1973, federal agencies are directed to use their authorities to seek to conserve endangered and threatened species. The 1986 Flathead National Forest plan contained management direction related to grizzly bear habitat, to provide specifically for recovery of the threatened grizzly bear. In 1995, Flathead National Forest plan amendment 19 was completed and resulted in establishment of new management direction related to motorized use of roads and trails and security for grizzly bears. Forest plan amendment 19 established limits on open motorized access density, total motorized access density, and security core for 54 of the 73 grizzly bear subunits across the Flathead National Forest portion of the NCDE.

The grizzly bear population in the NCDE has now met or exceeded recovery goals. In particular, habitat conditions and management actions on the national forests have contributed importantly to the increased population size and improved status of the grizzly bear across the NCDE. But, supporting a healthy, recovered grizzly population will depend on the Forest Service's continued, effective management of the NCDE grizzly bear's habitat.

In 2013, the USFWS announced the availability of a draft grizzly bear conservation strategy (GBCS) for the NCDE population for public review and input. When finalized, the GBCS will become the post-delisting management plan for the NCDE grizzly bears and their habitat. Adopting this document is necessary for the USFWS to demonstrate the adequacy of regulatory mechanisms in order to delist this grizzly population. Incorporating this strategy to the Flathead National Forest plan would likewise demonstrate the adequacy of regulatory mechanisms on the Flathead National Forest to support delisting. Thus, the Flathead National Forest proposes to update its forest plan where necessary to incorporate the relevant desired conditions, standards, guidelines, and monitoring items related to habitat management on NFS lands to support a recovered grizzly bear population.

The plan components included in the draft forest plan would replace A19 and other 1986 Flathead National Forest plan direction related specifically to grizzly bears in its entirety. However, until consultation with the USFWS has occurred and a decision has been made on the Flathead National Forest Plan Revision, the Flathead National Forest would continue to follow A19 direction.

The Flathead National Forest planning team is also coordinating the NEPA effort to incorporate and amend the relevant habitat-related desired conditions, standards, guidelines, and monitoring items from the GBCS into the Helena, Kootenai, Lewis and Clark, and Lolo NF Plans to ensure consistent direction related to grizzly bear habitat management on National Forest System lands throughout the NCDE.

The adoption of the GBCS includes incorporating the following management zones to the Flathead National Forest portion of the NCDE (figure B-01):

- **Primary conservation area –** the same as the recovery zone identified in the Grizzly Bear Recovery Plan (USFWS 1993);
- **Management zone 1–** a defined area surrounding the primary conservation area, within which grizzly bear population status and trend would be monitored;
- **Salish Demographic Connectivity Area-** a portion of Zone 1 with specific habitat measures to allow female grizzly bear occupancy and eventual dispersal to other ecosystems in the lower 48 states (i.e., the Cabinet-Yaak and Bitterroot ecosystems).

National Forest Service lands would no longer be designated as Management Situations 1, 2 or 3.

Within the Flathead National Forest portion of the NCDE PCA, key management direction from the GBCS is summarized below and incorporated into the draft forest plan components (see desired conditions, standards, and guidelines throughout this document for more detail):

- Open motorized route density, total motorized route density, and secure core would be maintained at baseline levels in each grizzly bear subunit, with certain exceptions. High use non-motorized trails would no longer be counted in calculations. Temporary increases in open and total motorized route densities and temporary decreases in secure core would be allowed for projects, as defined in the glossary;
- The food/wildlife attractant storage special orders would continue to apply across the forest;
- Developed recreation sites would be limited to one new site or increase in capacity in a bear management unit in a 10-year period, with certain exceptions;
- Vegetation management, livestock grazing, and minerals and energy development would be managed with consideration of grizzly bear habitat and to reduce the risk of grizzly bear-human conflicts.
- In the Swan Valley, the Swan Valley Grizzly Bear Conservation Agreement (SVGBCA) has coordinated timber harvest activities and associated road management across the multiple land ownerships in the Swan Valley since 1997. The SVGBCA applied to the following grizzly subunits: the South Fork Lost Soup, Goat Creek, Lion Creek, Meadow Smith, Buck Holland, Porcupine Woodward, Piper Creek, Cold Jim, Hemlock Elk, Glacier Loon, and Beaver Creek. Once the Flathead National Forest has consulted with the USFWS and made a decision on the Flathead National Forest Plan Revision, the Flathead National Forest would replace the SVGBCA that the Forest is currently following.
- In the Flathead National Forest portion of the Salish DCA and Zone 1, habitat protections focus on limiting miles of roads open yearlong to the public and managing current inventoried roadless areas (IRAs) as stepping stones to other ecosystems.

1.4.3 INFISH, native fish habitat, and riparian areas

By the beginning of the 1990's, there was great concern about stream habitat degradation in the western United States, as well as the potential loss of salmon, trout, and char populations (Nehlsen et al, 1991; Rieman and McIntyre, 1993). By the mid 1990's, The USDA Forest Service and Bureau of Land Management completed three broad reaching documents that amended forest plans across much of public lands in the west to improve their conservation function. Two of those documents were: *Record of Decision for Amendments to Forest Service and Bureau of Land Management Land Planning Documents Within the Range of the Northern Spotted Owl (often referred to as Northwest Forest Plan Record of Decision, 1994);* and the *Decision Notice/Decision Record for Interim Strategies for Managing Anadromous Fish-Producing Watersheds on Federal Lands in Eastern Oregon and Washington, Idaho and Portions of California (PACFISH, 1995).* Both of these documents greatly improved protection for migratory salmon and steelhead. While these documents influenced the development of *Inland Native Fish Strategy* (INFISH), they do not apply to the Flathead National Forest.

The last of the three broad strategies developed was the *Inland Native Fish Strategy-Interim Strategies for Managing Fish-Producing Watersheds in Eastern Oregon and Washington, Idaho, Western Montana and Portions of Nevada (INFISH 1995).* INFISH was designed to maintain options for inland native fish by reducing negative impacts to aquatic habitat. Riparian Management Objectives (RMOs), Standards and Guides, and monitoring requirements were implemented beginning in 1995 to avoid causing further damage and begin recovery of aquatic habitats. The Flathead National Forest Plan was amended by INFISH in 1995, and this strategy is still in effect on the Flathead National Forest.

INFISH was originally expected to last 18 months to three years while an effort similar to the Northwest Forest Plan, the Interior Columbia Basin Ecosystem Management Project (2014), was completed for the Interior Columbia River Basin. That strategy was never completed, but science from that effort has been retained in the form of guidance for plan revisions occurring in areas covered by INFISH and PACFISH. Interior Columbia Basin Ecosystem Management Project science and guidance is followed in this plan revision.

Since INFISH was implemented, there has been numerous changes to policy, best available scientific information, and the condition of listed species. There have been tremendous advances in knowledge regarding physical habitat and ecological interactions at many scales and across scientific disciplines, as well as advances in spatial data-base management. Scientists findings disclosed in BASI urge managers and biologists working to maintain and improve aquatic habitat to look beyond just the stream reach when considering how best to plan and implement project activities. Climate change science has also emerged as an important aspect of forest and river management since INFISH was adopted. These topics are further discussed in Appendices A, C, and E.

When instituted, Riparian Management Objectives (RMO's) were considered by many to be an important component of INFISH. RMO's were developed from PACFISH objectives measured in habitats across the range of anadromous fish in Washington, Oregon, and Idaho. The objectives selected were considered good indicators of ecosystem health, and were thought to be, "a good *starting point* to describe the desired condition for fish habitat."(INFISH, p. E-3, 1995- emphasis added). INFISH guidance recommended RMO values should "be refined to better represent conditions that are attainable in a specific watershed or stream reach based upon local geology, topography, climate and potential vegetation" (USDA 1995). Since INFISH was adopted on the Flathead, data has been collected locally by Forest personnel and used for comparison purposes in project design, consultation, and monitoring. Forest staff have found that of the six RMO categories listed in INFISH, the four that are most applicable to the Flathead are pool frequency, water temperature, large woody debris, and width/depth ratio because they apply to forested systems. Two other indicators, bank stability and lower bank angle, are not as applicable because they apply more favorably to non-forested systems of which the forest has limited amounts of that habitat. INFISH did not provide any sediment indicators as RMO's.

A monitoring data set similar to RMO's, yet collected systematically across Forest Service Regions 1, 4 and 6, is the PACFISH INFISH Biological Opinion (PIBO) data set. The PIBO monitoring effort resulted from PACFISH/INFISH consultations between the Forest Service, Bureau of Land Management, and regulatory agencies in 1998. The Forest Service and the Bureau of Land Management have continued to implement this integrated effectiveness monitoring program (Kershner et al., 2004) to the present day.

PIBO monitoring was developed to determine if components in PACFISH/INFISH were effective at preventing further habitat degradation at the scale of the entire Columbia River Basin, as well as on a watershed by watershed basis (Mostly subbasin [HUC8] or watershed [HUC10] level). This monitoring program collects reach-level stream habitat, temperature, macroinvertebrate, and riparian data to evaluate if key biological and physical components of aquatic and riparian communities are being degraded, maintained or restored. Unlike INFISH RMO's, the PIBO data set does collect sediment data. With over a decade of consistently collected data and improvements in data analysis, comparisons between managed and reference watersheds can now be scaled down to conditions on an individual National Forest. Currently, PIBO monitoring best meets the original intent of INFISH RMO's by providing rigorously collected local data that can be statistically compared to reference conditions in the same geophysical province.

In addition to monitoring and BASI improvements, bull trout became a listed species under the Endangered Species Act in 1998. The US Fish and Wildlife Service designated critical habitat for bull trout in 2010; the Northern Region of USDA Forest Service developed a Bull Trout Conservation Strategy for Forests in western Montana in 2013 (in response to guidance in INFISH to develop long term conservation strategy); and the US Fish and Wildlife Service released a Bull Trout Recovery Plan (USFWS, 2015a) and a Recovery Unit Implementation Plan for the Columbia Headwaters (USFWS, 2015b).

All of the changes previously discussed have created a need to update original INFISH Plan components for inclusion in the draft Plan and DEIS to improve how aquatic habitat is managed and to remain consistent with strategies in place across public lands in the western U.S. Comments received since the proposed action was published have been used where appropriate to improve the proposed action and have helped inform this draft EIS. In the draft plan and action alternatives, additional management direction has been included to address aquatic and riparian ecosystem integrity and connectivity. Components have been added to the proposed action that increase attention for watersheds identified for conservation (see Appendix E.) The Flathead Plan Revision is also being completed under the 2012 Planning Rule so text and style of original INFISH components have been adjusted to be compliant with the current Planning rule.

More specifically, a Conservation Watershed Network (CWN) has been identified and a restoration objective has been added under the Conservation Watershed Network section to help conservation watersheds be more resilient to climate change, i.e. less prone to damage caused by interaction between a warming climate and transportation corridors. The proposed Conservation Watershed Network in the revised forest plan is designed to provide that long term conservation strategy to conserve native fish in watersheds that are expected to be long term cold water refugia in the face of climate change (Isaak et. al 2015).

The draft Plan also proposes to use PIBO monitoring data, which is collected at a subset of sites on the forest every year, in combination with improved desired conditions. While the draft Plan does not contain numerical RMOs, descriptive desired conditions contained in the draft Plan (when compared to original INFISH Goals) would be used to guide project location and development. Because of the lag time between projects and effects, as well as the tremendous variability that can result from localized weather events, PIBO data analyzed at the Forest Scale is actually a more rigorous method to ascertain whether or not plan components designed to protect and restore the aquatic environment are effective. As funding allows, the Forest expects to continue to collaborate with MFWP and USFWS on completing bull trout redd counts. Electrofishing and genetic status monitoring of westslope cutthroat trout is also expected to continue in cooperation with MFWP. All of this information will enable the Forest to adapt its management strategies and adjust decisions in the future, if needed, based upon what has been learned.

Another change since the proposed action was published is the inclusion of a multi-scale analysis strategy in Appendix C. Multi-scale analysis, a refinement of watershed analysis, has been a widely applied methodology that was first required for use by the US Forest Service in the Pacific Northwest Region (Northwest Forest Plan, 1994). It was also described and recommended for use in the interior Columbia Basin key and priority watersheds by PACFISH and INFISH Strategies (1995), and is recommended for inclusion in plan revisions by the Interior Columbia Basin Ecosystem Management Project (2014) strategy. The multi-scale analysis strategy included in Appendix C has been simplified and clarified to sharpen focus on necessary integration.

The last noticeable changes in the revised plan since the Proposed Action was issued regard the name and width of riparian areas. Under INFISH, Riparian Habitat Conservation Areas (RHCA's) were designated around all water bodies. These areas have now been renamed Riparian Management Zones (RMZs) in alternatives B, C, and D. As compared to INFISH, RMZ widths are increased along mapped wetlands, ponds, and lakes to 300 feet (regardless of size) and intermittent streams will have a 100 foot RMZ width on all streams rather than 50 feet on some streams. This change will help ensure the Forest is consistent with the Montana SMZ law for slopes that are greater than 35% which, under law, require a 100 foot wide SMZ and provide for ecological functions of wetland plants and wildlife that were not covered under INFISH. The 2012 planning rule emphasizes integration of management direction in recognition of ecological sustainability and the interdependence of ecological resources, and expanding the RMZ in these critical areas will also contribute to wildlife habitat connectivity and protection of plant species and animal communities associated with wetlands.

1.4.4 Canada lynx habitat management

The 1986 forest plan contains a suite of direction designed to conserve and promote the recovery of Canada lynx which was incorporated into the plan in 2007 (USFS 2007). Since 2007, new information on Canada lynx has been published, including designation of critical habitat for Canada lynx (USFWS 2009, 2014), an updated version of the Lynx Conservation and Assessment Strategy (LCAS, Lynx Biology Team 2013), and scientific research results relevant to Canada lynx in northwest Montana.

The Forest is proposing to carry forward all the lynx management direction from the current forest plan (see appendix F) with two site-specific changes:

- A modification to vegetation standard VEG S6 to add an exception category to allow noncommercial removal of trees growing within 200 feet of mature whitebark pine (a candidate species for listing), identified as an important component of the restoration program. The intent is to reduce risk of loss of these seed-producing trees due to fire, insect and disease, and make them more resilient in the face of anticipated future environments (see FW-STD-TE&V-03). Standard VEG S5 already has an exception that allows pre-commercial thinning to restore whitebark pine, but VEG S6 does not provide a comparable exception.

- Varying the areas identified as suitable for over-snow motorized recreational vehicle use by alternative, which was addressed by human use guideline HU G11 (see FW-GDL-REC-05).

1.4.5 Inventoried roadless areas

Inventoried roadless areas are designated under the Roadless Area Conservation Rule (36 CFR Part 294 Subpart B). The Roadless Area Conservation Rule prohibits road construction or reconstruction and cutting, selling or removing timber in inventoried roadless areas unless a listed exemption applies. For example, one exemption allows the cutting, sale or removal of generally small diameter timber when it is needed to improve threatened, endangered, proposed or sensitive species habitat or to maintain or restore the characteristics of ecosystem composition and structure that would be expected to occur under natural disturbance regimes. The forest plan cannot modify Roadless Area Conservation Rule direction.

Currently on the Forest, there are 478,757 acres of inventoried roadless areas, which is about 20 percent of the Flathead National Forest (refer to figure B-02). The need for changing the management direction in the inventoried roadless areas from the 1986 forest plan is to remove inventoried roadless areas from the suitable timber base, and determine the recreation opportunity spectrum classification and the desired management area delineation.

1.4.6 Old growth forests

Amendment 21 was completed in 1999 and resulted in establishment of goals, standards and objectives in the 1986 forest plan related to the management of old growth forests and important associated stand structural components, such as snags and downed wood. The key features and intent of this direction has been retained in the draft revised forest plan, with refinements and augmentation based on new analysis and methodology, and to be consistent with the approach used with other vegetation management direction. These key features include maintaining and protecting existing old growth both at the stand and landscape level; limiting treatment activities within old growth; retaining snags and downed wood within harvest areas; and managing to develop future old growth. A notable change to the existing old growth direction is the change in the 1986 forest plan direction requiring managing landscapes to attain the 75% range around the median amount of historical old growth. Because old growth forest is site-specifically defined at the stand-level, there is no acceptable means of quantifying historical old growth forest. New direction in the draft revised plan associated with forest size classes (specifically the very large tree size class) and with very large live tree components would replace this existing plan direction. The new direction provides the means to estimate natural range of variation for forest structures associated with old growth forests, to manage landscapes for these desired old growth features, and to monitor trends over time.

1.4.7 Winter motorized recreation

Amendment 24 to the 1986 forest plan was implemented in 2006 and resulted in direction for over the snow winter motorized recreation, including when and where winter motorized recreation could occur. Amendment 24 designated specific routes and play areas, as well as seasons, for motorized over-snow use as per §212.81 of the Travel Management Rule. Specific routes and play areas and associated dates for over snow recreation identified with Amendment 24 were retained in the proposed action; however there was a need to propose changes to the boundaries of specific areas, as shown on the figures B-03 to B-05 in appendix B, as suitable or not suitable for over snow motorized recreation to address recreation sustainability.

The Flathead National Forest received input from the Whitefish Range Partnership collaborative group, expressing a desire to have a larger area open to over-snow motorized recreation in the area between Big Creek and Columbia Falls, Montana. In addition, other members of the public expressed a need to adjust the boundaries of areas that are currently open because some have grown in with vegetation and to improve the public's ability to recognize boundaries on the ground and assist the Forest Service in enforcing closure boundaries. In order to consider these recommendations but not impact key wildlife habitats, changes are being proposed in areas "suitable for over-snow motorized recreation," so that there would be no net increase in designated over snow routes or acres of play areas open to over-snow-use across the Forest. As shown in figures B-03 through B-05, the largest shift in acres would be in an area in the vicinity of Lookout Creek, Deep Creek, Depuy Creek, and McGinnis Creek in the North Fork Flathead River south of Big Creek that would become suitable for over-snow-use, while an equivalent acreage in the vicinity of upper Slide Creek, upper Sullivan Creek, and Upper Tin Creek in the South Fork Flathead River is being proposed as "not suitable for over-snow motorized recreation." The proposed changes would need to undergo subsequent site-specific analysis in order to be implemented and comply with 36 CFR parts 212 and 261.

1.5 Decision Framework

The responsible official for the analysis in volumes 1 and 2 is the Forest Supervisor for the Flathead National Forest. Based on the analysis and subsequent public comments, the responsible official will prepare a final environmental impact statement and identify a selected alternative in a draft record of decision that will be subject to an objection process guided by the direction in 36 CFR Subpart B (219.50 to 219.62). A final record of decision and accompanying draft forest plan sets a course of action for managing the Forest for the next 10 to 15 years. Project-level environmental analysis will still need to be completed for specific proposals to implement the direction in the forest plan. The decision framework for the amendment is discussed in volume 3, section 4.6.

1.6 Relationship to other entities

Forest Service planning regulations require the agency to consider other federal, state and local government, and tribal plans and policies. As part of the outreach effort, a number of discussions with federal, state, local, and tribal representatives were initiated and on-going dialogue continues with respect to incorporating their concerns, where possible.

1.6.1 **County governments**

Beginning with initiation of the planning process, local government officials from the counties within the Flathead National Forest lands were invited to participate in the development of the draft forest plans. The related and equivalent County plans were considered and evaluated for consistency throughout the planning process. Flathead County has a Natural Resource Use Plan that the Flathead National Forest has determined is generally compatible with the proposed plan for the Flathead National Forest except for certain goals and objectives (Forest Management, Fire, and Fuels Management, Recreation, Roads) that are incompatible with proposed plan components. The Flathead National Forest is committed to working with all local counties to better address the impacts and benefits from management of the Flathead National Forest.

1.6.2 **State**

Several Montana State agencies are affected by, or affect, Forest Service management. These include Montana Fish, Wildlife, and Parks, Montana State Department of Environmental Quality, Department of Natural Resource Conservation, and Montana Department of Transportation. The Forest coordinated information with Montana Fish, Wildlife, and Parks and Montana State Environmental Protection Agency during all phases of the process. These offices provided formal comments during the scoping and other public involvement stages. Statewide assessments were considered in the development of the draft forest plan.

1.6.3 **Tribes**

The forest supervisor and members of the planning team met a number of times with tribal representatives from the Confederated Salish and Kootenai Tribes during development of the draft forest plan. As a result, specific tribal comments were considered in this DEIS and draft forest plan.

1.6.4 **Federal**

Management of federal lands adjacent to the Flathead National Forest was considered in the formulation of alternatives and their cumulative effects. Consideration of national scenic and historic trails, utility corridors, recommended wilderness, and other management concerns across boundaries were discussed with Glacier National Park, Department of Homeland Security, Bureau of Reclamation, as well as adjacent national forests (Helena, Kootenai, Lolo and Lewis and Clark Forests).

1.7 Levels of Forest Service planning

Forest Service planning occurs at different organizational levels and geographic scales. Planning occurs at three levels—national strategic planning, National Forest System unit planning, and project or activity planning. The Chief of the Forest Service is responsible for national planning, such as preparation of the Forest Service strategic plan that established goals, objectives, performance measures, and strategies for management of the National Forest System. National Forest System unit planning results in the development, amendment, or revision of a land management plan. The supervisor or district ranger is the responsible official for project and activity planning (§ 219.2).

1.7.1 **National strategic planning**

The USDA Forest Service Strategic Plan: FY 2015-2020 contains four outcome-oriented goals for the Forest Service, each with strategic objectives. The strategic plan can be accessed online: www.fs.fed.us/strategicplan . The first two goals and related objectives are directly related to the current planning effort:

1. Sustain our Nation's forests and grasslands
    - Foster resilient, adaptive ecosystems to mitigate climate change
    - Mitigate wildfire risk
    - Conserve open space
2. Deliver benefits to the public
    - Provide abundant clean water
    - Strengthen communities
    - Connect people to the outdoors

The Resources Planning Act Assessment reports on the status and trends of the Nation's renewable resources on all forest and rangelands, as required by the Forest and Rangeland Renewable Resources Planning Act of 1974. The assessment includes analyses of forests, rangelands, wildlife and fish, biodiversity, water, outdoor recreation, wilderness, urban forests, and the effects of climate change on these resources. The most current assessment, Future of America's Forests and Rangelands: Forest Service 2010 Resources Planning Act Assessment, is available online (http://www.treesearch.fs.fed.us/pubs/41976 /). The report provides a snapshot of current United States forest and rangeland conditions (all ownerships), identifies drivers of change for natural resource conditions, and projects the effects of those drivers on resource conditions 50 years into the future. This assessment uses a set of future scenarios that influence the resource projections, allowing us to explore a range of possible futures for United States renewable natural resources. Alternative future scenarios were used to analyze the effects of human and environmental influences on our forests and rangelands, including population growth, domestic and global economic growth, land use change, and climate change.

In addition, the USDA Strategic Plan FY 2014-2018 has specific goals that also align with the 2012 planning rule, including 1) Assist rural communities to create prosperity so they are self-sustaining, re-populating, and economically thriving; and 2) Ensure our national forests and private working lands are conserved, restored, and made more resilient to climate change, while enhancing our water resources. Additional information about these strategic goals and amongst others can be downloaded from the USDA's web site at www.usda.gov.

1.7.2 National Forest System unit planning

The National Forest Management Act (NFMA) of 1976 (P.L. 94-588) amended the Forest and Rangeland Renewable Resources Planning Act of 1974. The NFMA requires the preparation of an integrated land management plan by an interdisciplinary team for each unit of the National Forest system (national forests and grasslands). Public involvement must be provided in preparing and revising forest plans. Forest plans must provide for multiple use and sustained yield of products and services, and include coordination of outdoor recreation, range, timber, watershed, wildlife and fish, and wilderness. The forest plan does not authorize site-specific prohibitions or activities; rather it establishes broad direction, similar to zoning in a community.

The forest plan revision process begins with preparation of an assessment to identify the need for change. The Flathead National Forest published an Assessment in April 2014. The Assessment, developed in accordance with the 2012 planning rule, evaluated existing information about relevant ecological, economic, and social conditions, trends, and sustainability, and their relationship to the land management plan within the context of the broader landscape. This information was used in describing current conditions and trends, identifying the need for change, and as a basis for the proposed action as well as alternatives.

1.7.3 Project or activity planning

The supervisor or district ranger is the responsible official for project and activity planning. Project or activity decisions will need to be made following appropriate procedures (e.g. site-specific analysis in compliance with the National Environmental Policy Act would need to be conducted), in order for prohibitions or activities to take place on the ground, which will be in compliance with the broader direction of the forest plan.

Chapter 2. Alternatives

2.1 Introduction

This chapter describes and compares the alternatives considered for the draft forest plan. It includes a discussion of how alternatives were developed, the primary issues raised, a description and map of each alternative considered in detail, and criteria common to all alternatives. This section presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public. This chapter also includes a discussion of the alternatives that were considered but not analyzed in detail and the rationale for not considering that alternative in detail.

2.2 Development of Alternatives

As discussed in chapter 1, this revision of the forest plan is based the requirements of the 2012 planning rule, findings from the Assessment, changes in conditions and demands since the 1986 Forest Plan, and public concerns. A list of significant issues was identified during scoping. These issues drove alternative development. Some additional items are addressed in the revision because they are required by planning regulations (i.e., (36 CFR § 219.17(3)(b)(1))).

The Council of Environmental Quality regulations, with respect to NEPA procedures and specifically the aspect related to Alternative development (36 CFR 40 §1502.14), are fundamental to the process, and thus important to include as follows:

This section is the heart of the environmental impact statement. Based on the information and analysis presented in the sections on the affected environment (§ 1502.15) and the environmental consequences (§ 1502.16), it should present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision maker and the public. In this section agencies shall:

a) Rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated.
b) Devote substantial treatment to each alternative considered in detail including the proposed action so that reviewers may evaluate their comparative merits.
c) Include reasonable alternatives not within the jurisdiction of the lead agency.
d) Include the alternative of no action.
e) Identify the agency's preferred alternative or alternatives, if one or more exists, in the draft statement and identify such alternative in the final statement unless another law prohibits the expression of such a preference.
f) Include appropriate mitigation measures not already included in the proposed action or alternatives.

Alternatives represent a range of possible management options from which to evaluate the comparative merits. Each alternative emphasizes specific land and resource uses and de-emphasizes other uses in response to the significant issues. This is primarily done by changing management area allocations, resulting in comparisons of the merits amongst the alternatives. Forest plans do not make budget decisions. Should Congress emphasize specific programs by appropriation, a redistribution of priorities would follow, regardless of the alternative implemented.

Alternative A is the no-action alternative, which reflects the 1986 forest plan, as amended to date, and accounts for current laws, regulations, and terms and conditions from biological opinions. Alternative B is the modified proposed action. This alternative is based on the detailed proposed action that was scoped in March 2015, with modifications in response to comments.

Development of alternatives C and D were driven by issues identified during public scoping. All reasonable alternatives to the proposed action must meet the purpose and need for change and address one or more of the significant issues. These alternatives are considered for detailed study. However, not all possible alternatives were carried into detailed study as the list of options would have been prohibitively large. Instead, the responsible official identified those alternatives that both met the criteria and created a reasonable range of outputs, direction, costs, management requirements, and effects from which to choose.

The Flathead National Forest has not identified a preferred alternative or alternatives at this point but plans to identify a preferred alternative in the final environmental impact statement after reviewing and considering the public comments on this draft environmental impact statement.

2.3 Public involvement

The Forest began public participation when developing the Assessment of the Flathead National Forest. To facilitate local participation, the Forest contracted with the U.S. Institute for Environmental Conflict Resolution in 2012 to develop a collaborative stakeholder engagement process. The U.S. Institute for Environmental Conflict Resolution met with Forest Service employees and a representative group of key stakeholders to determine their willingness to engage in a collaborative process convened by a neutral, third party. The Meridian Institute was selected to serve in that capacity and facilitated numerous topical work groups, an interagency group, and meetings to bring together all work groups and interested citizens. Beginning with a news release July 19, 2013, as part of the public involvement process, the Flathead National Forest led field trips and held open house sessions to discuss existing information and trends related to a variety of conditions found on the forest. From October 2013 through June 2014, the Flathead National Forest hosted monthly meetings with the intent to collaboratively develop plan components that the Forest could consider in the development of a proposed action. The dialogue and recommendations from this public involvement process was used to help develop the Flathead National Forest plan revision proposed action.

The notice of intent on the proposed action was published in the Federal Register on March 6, 2015. The notice of intent asked for public comment on the proposal for a 60-day period (until May 5, 2015). The comment period was subsequently extended by 10 days (until May 15, 2015). In addition, as part of the public involvement process, the agency held seven open houses to provide opportunities to better understand the proposed action so that meaningful public comments could be provided by the end of the scoping period. Using the comments from the public, other agencies, tribes, and organizations, the interdisciplinary team developed a list of issues to address. The list was then organized by issue applicability i.e., whether the issue was specific to the revision effort or specific to the amendment effort or applied to both. Issues that involve the amendment effort are discussed further in volume 3, section 5.4. Issues used for alternative development.

2.4 Issues used for alternative development

Issues serve to highlight effects or unintended consequences that may occur from the proposed action or alternatives. The Forest Service separated the issues identified during scoping into two groups: significant and non-significant issues. Significant issues were defined as those directly or indirectly caused by implementing the proposed action, involve potentially significant effects, and could be meaningfully and reasonably evaluated and addressed within the programmatic scope of a Forest Plan[2]. Alternatives were developed around those significant issues that involved unresolved conflicts concerning alternative uses of available resources.

The Forest Service identified the following significant issues during scoping that drove alternative development:

- Vegetation management, timber production, and fire and fuels management
- Wildlife habitat
- Access and recreation
- Recommended wilderness

2.4.1 Vegetation management, timber production, and fire and fuels management

Some people stated that the proposed action places too much emphasis on mechanical treatment methods and timber harvest to achieve desired vegetation conditions, and not enough emphasis on the use of natural ecosystem processes, which they indicated would provide greater benefits to wildlife. They would like to see fewer acres suitable for timber production. Others stated the proposed action places too little emphasis on the use of mechanical methods and timber harvest to achieve desired conditions, and does not provide an appropriate balance between the social, economic, and ecological aspects of the plan. Some also noted that this low level of treatments will not meet the forest fuel reduction needs for the purpose of reducing fire intensity in proximity to private lands. They would like to see more lands allocated to higher intensity timber management, and/or an increase in the acres suitable for timber production. Related to this issue is a desire by some to see an increase in the potential timber sale quantity (PTSQ), to provide what they feel would be a better balance between the social, economic and ecological aspects of the plan.

2.4.2 Wildlife Habitat

Some stated that the proposed action does not include adequate protections for wildlife habitat while others stated that protections are adequate and that more management flexibility is needed to move towards all desired conditions on the Forest, including those that support biodiversity. Some commended the Forest for addressing connectivity in the proposed action desired conditions but wanted greater consideration of habitat connectivity at multiple scales. Some want all wildlife plan components to be mandatory with measurable standards, while others want broad desired conditions or guidelines that allow for site-specific application at the project level.

[2] Some issues are best resolved at finer scales (subsequent NEPA) where the site specific details of a specific action and resources it affects can be meaningfully evaluated and weighed. Conversely, some issues have already been considered through broader programmatic NEPA (e.g. the NRLMD). In these cases, the issues focus on evaluating the effects unique to and commensurate with the decisions being considered here.

2.4.3 Access and recreation

Some people stated that the proposed action is too limiting to motorized opportunities and promotes non-motorized opportunities and that we need more motorized opportunities. Other people stated that we need additional closures on roads and trails to protect wildlife and increase the amount of non-motorized recreation and need less motorized opportunities.

2.4.4 Recommended wilderness

Some people stated the proposed action includes areas as recommended wilderness that do not meet the definition of the Wilderness Act and should not be in recommended wilderness management, while others feel we did not include enough areas in the proposed action as recommended wilderness. Some people did not want to see any additional recommended wilderness areas.

Some people stated that the proposed suitability call to allow existing mechanized transport and motorized use in recommended wilderness would not allow the area to be designated for wilderness by Congress or protect/maintain the social and ecological characteristics that formed the basis for recommendation. Some people felt that by not allowing existing and motorized use in areas recommended for wilderness the Forest is creating de facto wilderness and that social and ecological characteristics are protected and maintained by allowing existing motorized use and mechanized transport to continue.

2.5 Important points about all action alternatives

All action alternatives (B, C, and D) are based on the philosophies of multiple-use and ecological, social and economic sustainability. Alternatives B, C, and D provide basic protection of forest resources and comply fully with environmental laws. All the alternatives are designed to:

- Meet law, regulation, and policy;
- Incorporate ecosystem management objectives and strategies and contribute towards ecological, social, and economic sustainability;
- Meet the purpose and need for change and address one or more significant issues;
- Provide integrated direction as included in the forestwide desired conditions, objectives, standards, and guidelines;
- Allow for retaining all existing permitted activities and facilities[3]; and
- Provide sustainable levels of products and services.

2.6 Description of Alternatives

Alternative A, the “no-action alternative,” reflects current management practices under the 1986 Forest Plan, as amended and implemented, and provides the basis for comparing alternatives to current management and levels of output. While all alternatives provide a wide range of ecosystem services, multiple uses, goods, and services, some give slightly greater emphasis to selected resources based on the theme of the alternative and response to revision topics.

3 All permits will be reviewed for compliance with the new Plan. Any permit found to be out of compliance will be brought into compliance as soon as practicable using a variety of tools, including modifications or amendments to the permit.

Alternatives to the no-action alternative were based on the need for change, information described in the Assessment (2014), implementation and monitoring of the current Forest Plan, collaborative meetings (2013-2014), comments received during scoping, interagency meetings, and meetings with tribal partners. Alternatives represent a range of possible management options from which to choose. Each alternative emphasizes specific land and resource uses and de-emphasizes other uses in response to the revision topics. This is done primarily by changing management area allocations on the Flathead National Forest, resulting in trade-offs between the alternatives. In volume 1 of the DEIS some plan components for recommended wilderness and grizzly bear do vary between alternatives to address the issues identified in scoping, See the description of the alternatives for specific details.

2.6.1 Management areas

The draft forest plan would designate seven management area categories across the Forest. Allocation to a specific management area does not mandate or direct the Forest Service to propose or implement any action. The management areas provide additional direction that is specific to individual parcels of land within the Flathead National Forest that represent a management emphasis for that parcel of land. The management area direction includes desired conditions, standards and guidelines and suitability of certain uses within that MA.

For the action alternatives, management area prescriptions have been grouped into categories which have similar management characteristics. For example, MA1 is broken down into subcategories, which represent designated wilderness (MA1a) and recommended wilderness (MA1b). Management areas range from little human-caused alteration to the Forest (MA1 − wilderness) and focus on passive management to more human-caused change (MA7 − focused recreation areas) and focus on active management. Each alternative allocates different amounts of land to the MA. For a more complete description of categories and management areas prescriptions, see the modified proposed action. Refer to appendix 1 in volume 2 of the DEIS, figures 1-01 through 1-04 for maps of the management areas by alternative. Alternative A (the no-action, or current forest plan from 1986, as amended) was mapped with the proposed management areas from the draft forest plan (refer to table 3 for a crosswalk).

Table 3. A crosswalk of the proposed management areas (MAs) to the current management areas—the 1986 forest plan MAs

Proposed MAs	Category	Description	Current (1986 MAs)
1a	Wilderness Designated	The Forest manages three Congressionally designated wilderness areas – the Bob Marshall, Great Bear and Mission Mountains— as part of the National Wilderness Preservation System. If, over the life of this plan, Congress designates any additional wilderness areas on the Flathead, those areas would be allocated to this MA.	21, 22
1b	Recommended Wilderness	Areas are recommended as additions to the National Wilderness Preservation System. The wilderness characteristics and potential for each area recommended to be included in the National Wilderness Preservation System is to remain intact until Congressional action is taken.	Not an MA[1]
2a	Designated Wild and Scenic Rivers	River segments and adjacent lands that have been designated as part of the Wild and Scenic Rivers System under the authority granted by the Wild and Scenic Rivers Act of 1968, as amended. If, over the life of this plan, Congress designates any additional wild and scenic rivers on the Flathead, those areas would be allocated to this MA	18

Proposed MAs	Category	Description	Current (1986 MAs)
2b	Eligible Wild and Scenic Rivers	River segments and adjacent lands that have been identified as eligible for inclusion as part of the Wild and Scenic Rivers System under the authority granted by the Wild and Scenic Rivers Act of 1968, as amended.	Not an MA[2]
3a	Administrative Areas	Mapped Forest administrative sites.	10
3b	Special Areas	Special areas are administratively designated areas and managed to protect and conserve the values for which they were identified. The Forest currently has one special area, the Condon Creek Botanical Area.	3A
4a	Research Natural Areas (RNAs)	Established to provide for research, observation, and study and conservation of biological diversity. RNAs are designated jointly with the Forest Service Research Station.	3A
4b	Experimental, and Demonstration Forests	Coram Experimental Forest was established in 1933, and management is the responsibility of the Rocky Mountain Research Station. The Miller Creek Demonstration Forest was set aside in 1989. Its management is the responsibility of the Forest. The 1986 plan did not designate the demonstration forest as a management area.	14
5a, 5b, 5c, 5d	Backcountry	These areas provide a variety of backcountry recreational experience, ranging from non-motorized year round to motorized summer and over-snow areas/routes. They also include areas from the existing 1986 plan that have a high level of other amenity values or site conditions that would limit vegetation treatments and are unsuitable for timber production (i.e., high scenic value in elk winter range, non-forest types).	1, 2, 2A, 2B, 2C, 3, 11, 11A, 13A, 13D
6a	General Forest - Low	Timber management is expected to be at a low level of intensity due to other resource conditions, and lands are not suitable for timber production. Most of this area has roads, trails, structures, some signs of forest management activities, and provide a variety of recreation opportunities, both motorized and non-motorized.	12
6b	General Forest - Moderate	Timber management is expected to be at a moderate level of intensity. Lands are suitable for timber production, with timber harvest contributing to regulated timber harvest estimates. This area has roads, trails, structures, signs of forest management activities, and provides a variety of recreation opportunities, both motorized and non-motorized.	5, 7, 8, 9, 11C, 13, 15A, 15C, 15E, 16, 16A, 16B, 16C, 17
6c	General Forest - High	Timber management is expected to be at a high level of intensity. Lands are suitable for timber production, with timber harvest contributing to regulated timber harvest estimates. This area has roads, trails, structures, signs of forest management activities, and provides a variety of recreation opportunities, both motorized and non-motorized.	15, 15D
7	Focused Recreation Areas	Areas where certain types of recreational uses are featured and receive special attention.	4, 15B, 20

1. The 1986 plan identified five areas for recommended wilderness (see description of alternative A below and table 4), but they are not designated as a management area.

2. See table 5.

2.6.2 Elements common to alternatives

All alternatives in this document adhere to multiple use and sustained yield of goods and services (36 CFR 219.1 (b)). Forestwide, geographic area, and management area direction identified in the draft forest plan would apply to all action alternatives, with the exception of changed direction by alternative for grizzly bear, suitability of activities in recommended wilderness areas, timber objectives, and motorized over snow vehicle suitability. The primary difference between alternatives is the difference in allocation of acres by management area to meet the purpose and need for change and address one or more of the revision topics. Refer to chapter 1 in the draft forest plan for a description of how differences by action alternative are indicated (page 14).

The following would not change between alternatives:

- Management area and forestwide direction for desired conditions, standards, and guidelines remains constant for all action alternatives with exceptions noted above.
- Existing developed recreation sites and recreation residence special use permits are allowed for in all alternatives. Alternatives do not make decisions to remove or to create developed recreation sites.
- Management direction for utility and road rights-of-way, easements, and communication sites, and location of, remains constant for all alternatives.
- National Wilderness System lands and plan components remain constant for all alternatives.
- Designated and eligible wild and scenic rivers remain constant for all action alternatives.

2.6.3 Alternative A — no action

This alternative reflects the 1986 forest plan, as amended to date, and accounts for current laws and regulations. New information, inventories (e.g., tentatively suitable timber lands), and technologies (e.g., Spectrum model) were used to evaluate this alternative. Output levels were recalculated for this alternative based on forest plan amendments and new sources of information. The no-action alternative retains the 1986 management direction, as amended, including management area prescriptions. This alternative serves as the baseline for comparison with the action alternatives.

Alternative A relationship to significant issues

Vegetation management, timber production, and fire and fuels management

The 1986 forest plan (as amended) incorporates an ecologically based approach in many of the goals, standards and objectives related to vegetation conditions and associated wildlife habitat, both forest-wide and for potential vegetation types. This includes the concept of managing for vegetation conditions that would be expected to occur under natural succession and disturbance regimes, to reduce risk of undesirable effects from disturbances and maintain a resilient forest. In contrast to the action alternatives, this direction is mostly general descriptions, with no specific or quantitative desired conditions that would allow progress towards their achievement to be determined. There are no quantified objectives for treatment of acres to achieve plan objectives. Flexibility to use naturally ignited fire as a potential tool to manage vegetation outside wilderness is limited. Fuel reduction objectives to protect values on private lands is lacking.

In the 1986 plan, direction associated with timber production and outputs is largely focused on maximizing growth and yield, with a high proportion of regeneration harvest expected. Based on adjustments for plan amendments, new planning direction, and new data, lands suitable for timber production are 526,984 acres (22 percent of the Forest). Based on modeling for forest plan revision, the projected timber sale quantity (PTSQ) for the first decade is 28.2 MMBF/year and the projected wood sale quantity (PWSQ) 6.6 MMCF/year.

Wildlife and fish habitat

The ecological description and focus of many of the goals, standards and objectives related to vegetation composition, structure and function, as described in the section above, are directly linked to providing or protecting habitat for wildlife species associated with these forest communities, particularly old growth associated species. This direction contributes to maintaining and improving habitat conditions for wildlife over time. However, there are no desired conditions or direction for some vegetation communities that contribute to biodiversity and are important to species needing those habitats (e.g. burned forest, deciduous forest, and non-forest types). Little direction related to habitat connectivity is provided.

The 1986 plan (as amended) has forestwide objectives, standards and/or guidelines for species listed as threatened, endangered, or sensitive; MIS (e.g. big game species; species associated with old growth forests); species associated with dead and defective tree habitat; and the forest matrix. Some management areas also have a focus and direction to manage and protect specific wildlife habitat values, such as MA 11 (high quality grizzly bear habitat), MA 9 (whitetail winter range) and MA 13 (mule deer and elk winter range).

With this alternative, roads and trails open to public motorized vehicle use would need to be further reduced. The Forest estimates that approximately 518 miles of roads would need to be reclaimed, either on the transportation system as impassable or off the transportation system as decommissioned. Approximately 57 miles of trails would no longer allow wheeled motorized vehicle use in order to fully meet amendment 19 in each grizzly bear subunit, unless site-specifically amended. The estimated miles of roads and trails are based upon a programmatic analysis. The actual number may be higher or lower depending upon changing access condition on adjacent lands and the site specific factors that must be considered when evaluating access and grizzly bear habitat. Amendment 19 does not apply to portions of the Salish Geographic Area west of Highway 93, so motorized use would not need to be reduced there.

Access and recreation

Alternative A would continue to provide both motorized and non-motorized recreational opportunities as well as opportunities for mechanized transport (e.g., mountain bikes) and motorized over-snow vehicle use. As described under wildlife, additional roads and motorized trails would need to be evaluated for restrictions. Existing developed recreation sites would be maintained and there would not be limits on future development, other than those resulting from budget limitations or other forest plan direction. To fully implement alternative A, we estimate that public motorized vehicle use would be suitable on about 1,376 miles of roads and public wheeled motorized use would be suitable on about 169 miles of trails. Additionally, public motorized over-snow vehicle use would be suitable on about 1,964 miles of routes. Motorized over-snow vehicle use would be suitable on 31 percent of NFS lands and mechanized transport would be suitable on 52 percent of NFS lands.

Recommended wilderness

The 1986 Forest Plan recommended about 98,440 acres for wilderness designation. The five areas are: Alcove (9,998 acres), Jewel Basin (32,972 acres), Limestone Cave (5,076 acres), Slippery Bill (5,585 acres) and the Swan Front (44,815 acres). Alcove, Limestone Cave, the Swan Front, and Limestone Cave Recommended Wilderness areas are adjacent to the Bob Marshall and Great Bear designated Wilderness areas. Alcove, Limestone Cave and the Swan Front have closure orders that prohibit mechanized transport (mountain bicycle or game cart) and motorized use (wheeled and motorized over-snow vehicles). Slippery Bill Recommended Wilderness Area is open to mechanized transport. The Jewel Basin Hiking Area (15,283 acres) would continue to be within the Jewel Basin Recommended Wilderness Area (32,972 acres). The Jewel Basin Hiking Area would still retain prohibitions on stock and pack animals, mechanized transport and motorized uses. Outside of the Jewel Basin Hiking Area, but within the Jewel

Basin Recommended Area (17,689), there is an area which is identified as suitable for mechanized transport on 26 miles trails, and wheeled motorized use on 2 miles of trail these uses would continue.

2.6.4 Alternative B — modified proposed action

This alternative is based on the detailed proposed action that was published with the notice of intent in March 2015, with modifications in response to comments and refinements of the management area mapping. It is the result of public engagement efforts since 2013 and responds to the identified purpose and need. This alternative emphasizes moving towards desired future conditions and contributing to ecological, social, and economic sustainability.

To develop alternative B, the following corrections and refinements were made to the mapped management areas of the March 2015 proposed action:

- Correction of mapping errors: including changing areas of MA 1b that were not in wilderness inventory areas; fixing errors in MA 2a mapping (designated Wild and Scenic Rivers); and correctly matching MA 5c areas based upon the current over-snow vehicle use maps.
- Changing some areas due to closer evaluation of management and site limitations that would affect feasibility of vegetation treatments or other activities associated with the management area.
- Changing some designations to be consistent in our management area mapping strategy, which considers RMZs as inclusions within other management areas rather than a separate management area. This mostly involved incorporating RMZ areas that were mapped as MA6a buffers along some streams into the adjacent management area designation.
- Changing some designations based on consideration of public comment, such as including a small area of MA 6a in upper Teepee/Ninko area into adjacent MA 1b; reducing the area mapped as MA 5c (over-snow use) in the Nasokoin Peak area (mapped to the original boundary proposed by Whitefish Range Partnership); adding a small expansion of the Fatty Creek Special Area.
- Adding eligible Wild & Scenic River (MA 2b-wild) in the Upper Swan River, from the confluence with Lindbergh Lake up to Crystal Lake in the Mission Mountains Wilderness.

In developing alternative B, modifications were made to plan components in the proposed action direction (refer to chapter 1 of the draft forest plan for description of key modifications) and also in the plan appendices.

Alternative B relationship to significant issues

Vegetation management, timber production, and fire and fuels management

Desired conditions for vegetation are based on maintaining and promoting forest conditions that are resilient in the face of potential future disturbances and climate change, and contribute to social and economic sustainability. A variety of vegetation management techniques would be employed, including timber harvest, planting, thinning, fuel treatments, natural unplanned ignitions, and prescribed burns). The role of fire, both planned and unplanned ignitions, as a tool to achieve desired vegetation and wildlife habitat conditions is articulated in the plan, and direction related to its use and management is provided. Direction is also provided for fuels management to protect identified values, such as in wildland urban interface areas. Biodiversity is addressed by providing desired conditions and management direction associated with a diverse array of plant communities and species, including deciduous forests, burned forests, grass/shrublands, whitebark pine and species of conservation concern. Fens and other unique botanical/geological areas are given special emphasis by designation as management area 3b Special Areas.

Timber harvest is conducted to provide for societal goods and to move the vegetation towards desired conditions. There are approximately 499,066 acres suitable for timber production as defined by the 2012 planning rule (or 21 percent of the Forest). The projected timber sale quantity for the first decade is 27.4 MMBF/year and the projected wood sale quantity is 6.3 MMCF/year.

Wildlife and fish habitat

Alternative B has forestwide desired conditions, objectives, standards and/or guidelines to support long-term persistence of species listed as threatened, endangered, or species of conservation concern; and to support key ecosystem characteristics for species of interest for hunting, trapping, observing and subsistence. This alternative includes 1,072,040 acres in designated wilderness (MA1a), 187,741 acres in recommended wilderness (MA1b) and 315,529 acres in backcountry (MA5a through d), to provide habitat security and connectivity of large land areas for species that are sensitive to higher levels of human disturbance (e.g. grizzly bear). These management areas also emphasize natural processes, with relatively high levels of habitat created by natural disturbances, such as wildfire, insects or disease. The close inter-relationship of vegetation conditions and wildlife habitat is emphasized, and forest plan components related to vegetation conditions provide key ecosystem characteristics that support wildlife habitat needs and diversity (e.g. species associated with old growth forests; species associated with dead and defective tree habitat; and habitat connectivity). Management direction is proposed to address key aquatic and riparian ecosystem characteristics and their integrity, to address resilience in light of a changing climate and anticipated future environment. Along with fish habitat and water quality, wildlife habitat is emphasized in riparian management zones (RMZ's). Outside of RMZ's, coniferous forests in MAs 6b and 6c, some MA 7 areas, and the Miller Creek Demonstration Forest (MA 4b) are suitable for timber production and provide opportunities for active management of vegetation to move towards desired vegetation composition, structure, function, and distribution.

Alternative B would adopt the habitat-related management direction of the draft NCDE Grizzly Bear Conservation Strategy including limits on new grazing allotments, vegetation management guidelines, and mitigation for mineral development on some lands. It would maintain baseline conditions for motorized road access across the Forest which have supported recovery of the grizzly bear, but would not require additional closure of roads and trails open to public motorized vehicle use. This alternative would carry forward the objectives, standards, and guidelines that were developed to conserve the Canada lynx, with modification of VEG S6 to add an exception category aimed at protecting mature rust-resistant whitebark pine trees, and modifying the areas identified as suitable for over-snow motorized recreational vehicle use.

Access and recreation

Existing or slightly reduced levels of motorized road access could be expected to support social and economic sustainability while addressing desired ecological conditions for soils, water, fish or wildlife. Some additional motorized trail access could occur in grizzly bear management zone 1, outside of the Salish demographic connectivity area. Alternative B would provide the opportunity for public motorized vehicle use (suitable on designated roads and trails) on about 1,657 miles of the Forest. Motorized over-snow vehicle use would be suitable on 31 percent of the Forest and mechanized transport (e.g., mountain bikes) would be suitable on 52 percent of the Forest. Based upon public collaboration and comment, as well as, site-specific ecological conditions, the areas suitable for motorized over-snow vehicle use would be shifted from some parts of the forest to others, resulting in a net decrease of about 6580 acres. To reduce the risk of grizzly bear-human conflicts on NFS lands in light of increasing human use of the national forests in the future, there could be limits on the number and capacity of new developed recreation sites in the primary conservation area for grizzly bears. Outside of the primary conservation area, the number of developed recreation sites could be increased or their capacity could be expanded to meet increased use.

Recommended wilderness

This alternative has 9 areas totaling 187,741 acres for recommended wilderness. This alternative includes a plan component that ***existing*** mechanized transport and motorized use would be suitable in recommended wilderness area if the ecological and social characteristics that provide the basis for wilderness recommendation are protected and maintained. This plan component was developed to respond to public concerns that agency-recommended wilderness should not be managed in the same way as Congressionally-designated wilderness.

In the North Fork Geographic Area there is one area recommended for wilderness - Tuchuck-Whale (80,708 acres).

- In the Swan Valley Geographic Area there are two areas recommended for wilderness to be added to the Mission Mountains Wilderness; Elk Creek (2,032 acres), and Fatty Creek (973 acres). There is one area recommended for wilderness to be added on to the Bob Marshall Wilderness; Swan Front (45,330 acres).
- In the Middle Fork Geographic Area there are two areas recommended for wilderness; Java-Bear Creek (1,824 acres), and Slippery Bill (7,225 acres).
- In the Hungry Hose Geographic Area there is one area recommended for wilderness; Jewel Basin (21,996 acres).
- In the South Fork Geographic Area there are two areas recommended for wilderness to be added to the Bob Marshall Wilderness; Limestone-Dean (15,026 acres), and Alcove (12,627 acres).

Existing mechanized transport or motorized over-snow vehicle use would be suitable and could be allowed to continue in Fatty Creek Recommended Wilderness Area (motorized over-snow vehicle use) and Tuchuck-Whale Recommended Wilderness Area and Slippery Bill (mechanized transport).

2.6.5 Alternative C

Alternative C has more acres of recommended wilderness than the other alternatives. Primitive or semi-primitive non-motorized recreational opportunities would be increased by identifying motorized and mechanized transport as not suitable in proposed wilderness areas. This alternative also adds several forest plan components (the same as under those alternative 3 in volume 3 for the amendment forests) that provide additional protections for grizzly bear habitat.

The primary differences of alternative C compared to other alternatives include the following:

- Areas that are within both the wilderness inventory area and inventoried roadless areas are designated MA 1b (recommended wilderness). Additional areas within wilderness inventory area are also designated MA 1b, as guided by public comment and to improve manageability (i.e., reduce “cherry stems” within recommended wilderness). This change concurrently results in a large reduction in areas suitable for public motorized vehicle use on a year-round basis.
- Krause Basin MA 7 is changed to MA 6a, and summer motorized use is suitable only on the existing open road.
- Draft forest plan component changes:

♦ Management direction for MA 1b (recommended wilderness) is changed so that motorized use and mechanized transport (i.e. mountain bikes, chainsaws) would not be suitable.

- ♦ Many of the grizzly bear plan components for vegetation, grazing, and minerals that apply to the grizzly bear primary conservation area for alternatives B and D would also be applied to the Salish demographic connectivity area and/or zone 1 for alternative C. Any new oil and gas leases in the primary conservation area and zone 1 (including the demographic connectivity areas) would have to include a no surface occupancy stipulation.
- ♦ In three of the areas currently suitable for late-season over-snow motorized use (after March 31), late season use would not be suitable. There would be no increase above the baseline acreage of areas and miles of routes that are open to over-snow vehicle use in the den emergence time period.
- Some additional motorized trail access could occur in grizzly bear management zone 1, but only outside of the Salish Demographic Connectivity Area.
- Roads located within grizzly bear secure core could not be opened for temporary use by the public.
- New or re-authorized permits for ski areas would have to include mitigation measures to reduce the risk of grizzly bear-human conflicts.

Alternative C relationship to significant issues

Vegetation management, timber production, and fire and fuels management

Similarly to alternative B, direction related to vegetation focuses on maintaining and developing resilient forest conditions. In this alternative, greater reliance is placed on natural disturbances such as fire (unplanned and planned ignitions) and less on mechanical management techniques (e.g., timber harvest, mechanical fuel treatments, thinning, planting) as tools to achieve desired vegetation conditions. Timber harvest is conducted to move the vegetation towards desired conditions while providing societal goods. This alternative has the lowest amount of acres (317, 301 acres, or 13 percent of the Forest) suitable for timber production. The projected timber sale quantity for the first decade is 18 MMBF/year and the projected wood sale quantity is 4.5 MMCF/year.

Wildlife and fish habitat

Alternative C has forestwide desired conditions, objectives, standards and/or guidelines to support long-term persistence of species listed as threatened, endangered, or species of conservation concern; and to support key ecosystem characteristics for species of interest for hunting, trapping, observing and subsistence. Management direction is proposed to address key aquatic and riparian ecosystem characteristics and their integrity, to address resilience in light of a changing climate and anticipated future environment. Because the Forest needs to continue to support a recovered NCDE grizzly bear population, roads open to public motorized vehicle use could not exceed baseline levels. However, due to the indirect effect of increased wilderness acres and associated management direction, baseline levels of motorized road and trail access could actually decrease. Relatively, this alternative would provide the highest habitat security and connectivity for species that may be sensitive to higher levels of human disturbance. In response to public comment on wildlife habitat values (e.g., grizzly bear habitat, key big game winter habitat, high-value lynx habitat, habitat corridor/connectivity areas), general forest management areas (MA 6a, b, c) were reviewed and some areas are changed to management areas where less intensive vegetation management could be expected (such as MA 6b changed to MA 6a).

Access and recreation

Alternative C would provide the opportunity for public motorized vehicle use (suitable on designated roads and trails) on approximately 1,657 miles on NFS lands on the Flathead National Forest. Motorized over-snow vehicle use would be suitable on 25 percent and mechanized transport (e.g., mountain bikes) on 34 percent of the Flathead National Forest. Dispersed recreation opportunities would continue to be available. As a result of increased recommended wilderness and associated management direction, areas suitable for motorized over-snow vehicle use would be decreased by about 107,515 acres (open from Dec. 1- March 31), compared to the no action alternative. To reduce the risk of grizzly bear-human conflicts on NFS lands in light of increasing human use of the national forests in the future, there could be limits on the number and capacity of new developed recreation sites in the primary conservation area for grizzly bears. Outside of the primary conservation area, the number of developed recreation sites could be increased or their capacity could be expanded to meet increased use.

Recommended wilderness

This alternative has 17 areas totaling about 506,919 acres for recommended wilderness. This alternative includes a plan component that mechanized transport and motorized travel and uses would not be suitable uses in recommended wilderness area in this alternative. This plan component responds to the public concern that if existing mechanized transport and motorized travel and uses would be allowed to continue, the social and ecological characteristics that provide the basis for suitability for inclusion into the National Wilderness preservation System would not be protected or maintained, thereby reducing the wilderness potential of an area to be designated.

- In the North Fork Geographic Area there are three areas recommended for wilderness: Tuchuck-Whale (90,638 acres), Coal (45,257 acres), and Canyon (7,939 acres).
- In the Salish Mountain Geographic Area there is one area recommended for wilderness: LeBeau (5,950 acres).
- In the Swan Valley Geographic Area there are four areas recommended for wilderness to be added to the existing Mission Mountains Wilderness: Cold-Jim (317 acres), Elk Creek (2,964 acres), Fatty-Woodard Creek (2,133 acres) and Piper Creek (642 acres). There is one area recommended for wilderness to be added on to the Bob Marshall Wilderness: Swan Front (48,151 acres) and a portion of the Alcove-Bunker Recommended Wilderness Area. There is a portion of the Jewel Basin-Swan Crest Recommended Wilderness Area in this geographic area.
- In the Middle Fork Geographic Area there are 4 areas recommended for wilderness: Essex (13,788 acres), Java-Bear Creek (3,725 acres), Sky West (5,193 acres), Slippery Bill-Puzzle (20,703 acres).
- In the Hungry Hose Geographic Area there are two areas recommended for wilderness: Hungry Horse East (33,503 acres), Jewel Basin-Swan Crest (135,759 acres) and a portion of the Alcove-Bunker Recommended Wilderness Area.
- In the South Fork Geographic Area there are two areas recommended for wilderness to be added to the Bob Marshall Wilderness: Limestone-Dean (26,294 acres), and Alcove-Bunker (63,962 acres). There is a portion of Hungry Horse East Recommended Wilderness Area in this geographic area.

2.6.6 **Alternative D**

This alternative emphasizes active vegetation management, including timber harvest, to achieve desired conditions. There is an expected higher level of management intensity with more acres of MA 6c, though total acres suitable for timber production is similar to the modified proposed action. . There is more emphasis on semi-primitive motorized and roaded recreation opportunities. No recommended wilderness is included in alternative D. Additional MA 7 areas are designated (focused recreation areas), including an area featuring off-highway single-track motorized recreational opportunities and additional areas of non-motorized emphasis.

The primary differences of alternative D to other alternatives include the following:

- Most of the areas designated MA 1b (recommended wilderness) are changed to a backcountry MA 5 designations.
- Motorized over-snow vehicle routes and area suitability is mostly as described in the existing Forest Plan (Amendment 24), except within the North Fork GA and in Skyland/Challenge Creek area. In the North Fork, the Whitefish Range Partnership recommendations to increase the areas suitable to over-snow motorized use were followed, except in the Nasokoin Peak and Whale Lakes areas. Over-snow suitability was expanded in these areas to reflect public comment. In the Skyland/Challenge area, some of the MA 6a areas that are outside wolverine maternal denning habitat would become suitable for over-snow use and an open area at the end of the Puzzle Creek Road in the Skyland drainage would become unsuitable. New areas would be suitable for motorized over-snow vehicle use only from Dec 1 to March 31.
- In response to public comment on economic and social sustainability, general forest management areas (MA 6a, b, c) were reviewed and some areas are changed to management areas where more intensive vegetation management could be expected (such as MA 6b changed to MA 6c). Factors considered included management feasibility, access, site conditions, values at risk for wildland fire (i.e. adjacent private lands) and wildlife habitat standards. Most of these changes occurred in the wildland urban interface.
- Additional and expanded focused recreation areas (MA7): Six additional MA7 areas would be designated, including an area featuring motorized single track opportunities in the Salish GA and additional areas to the east and west of Big Mountain. These areas near Big Mountain follow the Whitefish Range Partnership suggestions and concept of a front-country recreation area. Summer motorized suitability would not change in this area, but would be more focused on summer non-motorized use.
- An additional area of MA 5b is added at the head of Conner Creek (Hungry Horse Geographic Area), identifying it as suitable for summer motorized vehicle use.
- A portion of the backcountry MA 5a area along Whitefish Divide adjacent to Stillwater State Forest is changed to MA 6a, to address comments desiring greater flexibility in accessing and managing this area (by both DNRC and USFS).

Alternative D relationship to significant issues

Vegetation management, timber production, and fire and fuels management

Similarly to alternative B, direction related to vegetation focuses on maintaining and developing resilient forest conditions. Higher emphasis on use of active vegetation management would occur, such as timber harvest, thinning, planting, mechanical fuel reduction and prescribed fire. Natural disturbance processes would remain a primary source of vegetation change and movement towards desired conditions forest wide. This alternative allows for the highest amount of timber production from suitable timberlands. There are 500,445 acres (21 percent of the Forest) suited for timber production. The PTSQ for the first decade is 29.2 MMBF/year and the PWSQ is 6.8 MMCF/year.

Wildlife and fish habitat

Alternative D has forestwide desired conditions, objectives, standards and/or guidelines to support long-term persistence of species listed as threatened, endangered, or species of conservation concern; and to support key ecosystem characteristics for species of interest for hunting, trapping, observing and subsistence. The close inter-relationship of vegetation conditions and wildlife habitat is emphasized, and forest plan components related to vegetation conditions provide key ecosystem characteristics to support wildlife habitat needs and diversity (e.g. big game species; species associated with old growth forests; species associated with dead and defective tree habitat; and habitat connectivity), but using more active management than alternative C. Management direction is proposed to address key aquatic and riparian ecosystem characteristics and their integrity, to address resilience in light of a changing climate and anticipated future environment. Along with fish habitat and water quality, wildlife habitat is emphasized in riparian management zones (RMZ's). Outside of RMZ's, coniferous forests in MAs 6b and 6c, some MA 7 areas, and the Miller Creek Demonstration Forest (MA 4b) are suitable for timber production and provide opportunities for active management of vegetation to manage for desired vegetation composition, structure, function, and distribution. Since MA 6b areas in the wildland-urban interface are changed to MA 6c this alternative has the most opportunity for active management of vegetation to restore historic composition, structure, function, and distribution in the valley bottoms/areas of intermingled ownership in the warm, dry and warm, moist biophysical settings. This alternative would place less emphasis on retention of cover in big game winter range areas in the Salish and Swan Valley GAs than alternatives A, B, or C.

Like B, alternative D would adopt the habitat-related management direction of the draft NCDE Grizzly Bear Conservation Strategy including limits on new grazing allotments, vegetation management guidelines, and mitigation for mineral development on some lands. It would maintain baseline conditions for motorized road access across the Forest which have supported recovery of the grizzly bear, but would not require additional closure of roads and trails open to public motorized vehicle use. Some additional motorized trail access could be suitable in zone 1, including the Salish Demographic Connectivity Areas. This alternative would retain the existing objectives, standards, and guidelines for lynx, with forest-specific modifications as described for alternative B.

Access and recreation

Motorized over-snow vehicle use would be suitable on roads and trails on about 1,964 miles, motorized over-snow vehicle use would be suitable on 770,969 acres (32%) and mechanized transport (e.g., mountain bikes) on 52 percent of the Forest. Dispersed recreation opportunities would continue to be available. Based upon public collaboration and comment, the areas suitable for motorized over-snow vehicle use would be added in some parts of the forest but would not be offset by making other areas unsuitable, resulting in a net increase of about 17,940 acres (open from Dec. 1- March 31) compared to the no action alternative. To reduce the risk of grizzly bear-human conflicts on NFS lands in light of increasing human use of the national forests in the future, there could be limits on the number and capacity of new developed recreation sites in the primary conservation area for grizzly bears. Outside of the primary conservation area, the number of developed recreation sites could be increased or their capacity could be expanded to meet increased use.

Recommended wilderness

No areas are included in this alternative to be managed as recommended wilderness.

2.6.7 Alternatives considered but eliminated from detailed study

Federal agencies are required by National Environmental Policy Act to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received in response to the proposed action provided suggestions for alternatives, a number of which were considered. The rationale for eliminating a potential alternative from detailed consideration is summarized below.

The 2006 proposed forest plan

The 2006 proposed forest plan was considered as a basis for developing the proposed action as well in the development of alternatives B, C, and D. The 2006 proposed forest plan is sufficiently reflected amongst the alternatives (e.g. suitable timber base in alternative C is similar to 2006 proposed forest plan suitable timber base acres) and therefore an alternative that is specifically the 2006 proposed plan was not developed and will not be carried forward as an independent alternative.

Wilderness and inventoried roadless area related alternatives

Some commenters wanted to see inventoried roadless areas be managed as recommended wilderness. This alternative is largely being reflected in alternative C which includes inventoried roadless areas within the wilderness inventory area. In alternative C, those areas outside the wilderness inventory area generally went to backcountry management area or general forest area low intensity. Total acres of inventoried roadless areas on the Flathead National Forest is 478,757 acres; alternative C recommended 506,919 acres wilderness which is 27,946 acres above the total of inventoried roadless areas on the forest but that acreage does not include all inventoried roadless areas such as the Swan River Island inventoried roadless areas which was not included in the wilderness inventory criteria.

Some commenters wanted all lands within the wilderness inventory area as recommended wilderness but as this was a broad inventory, not all acres within this inventory had wilderness characteristics.

No winter motorized recreation alternative

Some commenters proposed allowing no motorized over-snow vehicle use, in order to eliminate any potential impacts on grizzly bears, Canada lynx, wolverines and other wildlife, while others stated that science showing over-snow use is detrimental to wildlife is not defensible. As stated in the draft GBCS (USFWS 2013) and 5-year review on the status of the grizzly bear (USFWS 2011) there is no known or discernible impact from current levels of winter motorized recreation evidence on the population of grizzly bears in the NCDE. The NCDE population has recovered with existing motorized over-snow vehicle use. For lynx, The USFWS stated that after evaluating Bunnell *et al.* (2006, entire) and Kolbe *et al.* (2007, entire), they determined that the best information available did not indicate that compacted snow routes increase competition from other species to levels that adversely impact lynx populations (USFWS 2014). Dr. John Squires also stated on a public field trip during the Flathead National Forest plan revision process that he agreed with the findings of other researchers regarding snow compaction. Similarly, direct effects of current levels of motorized over-snow vehicle use on forest roads do not appear to adversely affect lynx (Squires 2010). Heinemeyer and Squires are investigating winter recreation use in wolverine habitat in Idaho and state that wolverines appear to tolerate winter recreation in their home ranges, including denning females. Based on their preliminary findings, potential wolverine habitats that have even high levels of winter recreation may support resident wolverines despite the potential human disturbance. However, the authors are still investigating variability of wolverine response to human disturbance and don't expect to have results until the fall of 2016 (Heinemeyer and Squires, 2014). In summary, the science does not support the need for this kind of alternative.

Some commenters wanted to reduce motorized over-snow vehicle use opportunities on the forest to make it more equitable for non-motorized winter users and allow for solitude. Alternative C largely reflects this with less acres suitable for motorized over-snow vehicle use.

Grizzly bear alternatives

Some commenters suggested plan components to provide a lower or higher level of protection of grizzly bear habitat or to better assure movement of bears between recovery areas. For various reasons explained in volume 3, some of the items suggested by the public were not included in alternatives because they are outside the scope of the action, do not meet the purpose and need, are conjectural and not supported by scientific or factual evidence, or would be infeasible to implement.

Canada lynx alternatives

Some commenters suggested that the Flathead National Forest retain existing objectives, standards and guidelines from the Northern Rockies Lynx Management Direction (USDA 2007), or include plan components to provide a higher or lower level of protection for Canada lynx or its critical habitat. Alternative A, the no-action alternative, carries forward the existing management direction, with two modifications proposed under the action alternatives B, C, and D. The following items suggested by the public were not included in alternatives considered for detailed analysis because they are outside the scope of the action, do not meet the purpose and need, are conjectural and not supported by scientific or factual evidence, or would be infeasible to implement.

Apply information in Kosterman's 2014 thesis to Canada lynx management direction in the Forest Plan Revision

Some commenters suggested that the draftforest plan incorporate information from Kosterman's 2014 thesis into its management direction for Canada lynx. The thesis, "Correlates of Canada lynx reproductive success in northwestern Montana", evaluates the effects of habitat and maternal covariates on reproductive success of female lynx within a portion of the species' southern range in northwestern Montana.

While the 2014 thesis provides valuable new information with potential to inform changes in Forest Service management of lynx and lynx habitat, the relationships between vegetation composition and lynx reproductive success described in the thesis are not well enough understood to determine if, or what, specific changes in management direction are warranted. By design, the 2014 thesis classified vegetation in a way that was deliberatively imprecise in order to allow the researcher to correlate lynx demography to habitat in a simple and rough sense. For this purpose, the classification was a success. However, the parameters and metrics that Kosterman used do not directly cross-walk to Forest Service vegetation inventory data or the management direction established by the Northern Rockies Lynx Management Direction. Two examples are summarized below.

VEG S1. The 30% threshold value for a lynx analysis unit in early stand initiation structural stage under standard VEG S1 is not directly comparable to the 10-15% optimum level of young regenerating forest identified in the 2014 thesis. Kosterman grouped vegetation into five categories, one of which was young regenerating forest. The VEG S1 standard threshold of 30% could include vegetation in at least three of the five vegetation categories described by Kosterman, including: 1) open – trees not present; 2) thin forest; and, 3) young regenerating forest. Thus, the optimum 10-15% amount of young regenerating forest identified by Kosterman appears to be a subset of the early stand initiation structural stage used to calculate the 30% threshold under VEG S1.

VEG S6. The greater than 50% mature forest optimum vegetation class described by Kosterman is broadly defined as large trees with continuous canopy and no evidence of recent disturbance. This class could include a wide range of stand conditions, including mature stands of single-storied trees with little to no understory (stem exclusion structural stage), and mature stands of multi-storied trees with dense understories. The latter category provides the snowshoe hare habitat addressed by Standard VEG S6. The mature vegetation class in the thesis does not distinguish between single versus multi-storied mature forest structures and does not address understory horizontal cover metrics within lynx home ranges included in the study. Thus, the optimum 50% amount of mature forest identified in the 2014 thesis appears to include a wider range of mature forest structural types than those addressed under VEG S6.

Until the actual structural makeup of those mature forest stands within the lynx home ranges are better understood, it will not be possible to identify whether or how the forest plan direction should be changed.

Ms. Kosterman and Rocky Mountain Research Station scientists are working to publish the results of her study in a peer reviewed scientific journal. Some of the analysis or findings in the original thesis may change through that process.

For these reasons, the information in the thesis cannot be used to develop an alternative at this time. Forest Service staff will continue to work in partnership with USFWS, the Rocky Mountain Research Station and Ms. Kosterman to determine the appropriate application of her information to the management of Canada lynx habitat (planning record exhibit V-40).

Do not allow any management in Canada Lynx Critical Habitat

Some commenters suggested that management in lynx critical habitat is illegal and should not be allowed. However, the Endangered Species Act does not automatically restrict all uses of critical habitat, but only imposes restrictions under section 7(a)(2) on Federal agency actions that may result in destruction or adverse modification of critical habitat. The USFWS stated that the scale of any activity should be examined to determine whether direct or indirect alteration of habitat would occur to the extent that the value of critical habitat for the survival and recovery of lynx would be appreciably diminished. In their designation of critical habitat for Critical Habitat Unit 3 (Northern Rocky Mountains), the Service stated, "Timber harvest and management are dominant land uses (68 FR 40075); therefore, special management may be required depending on the silvicultural practices implemented. Timber management practices that provide for a dense understory are beneficial for lynx and snowshoe hares" (USFWS 2009, 2014). Therefore, all alternatives provide protections for lynx critical habitat and allow for vegetation treatments where consistent with those protections. Lands suitable for these vegetation treatments vary by alternative.

Reduce the level of protection for the Canada lynx

In response to the proposed action, some commenters suggested that the level of protection of Canada lynx habitat should be further reduced in order to allow more development and use of natural resources. The best available scientific information was used to inform the planning process, including plan components to support key ecosystem characteristics for a recovered Canada lynx population and contribute to its long-term persistence. Relaxing or eliminating those forest plan components would not meet the purpose and need for the action.

Change the area of mapped Canada lynx habitat

Some commenters suggested that the Forest lynx habitat map is faulty and includes too little or too much area and should be revised. Some assert that all critical habitat should be mapped as lynx habitat. Others assert that lynx habitat should be mapped at the project level. Critical habitat was mapped at a broad scale. Within the geographical area occupied by the lynx at the time of listing, the USFWS identified the physical and biological features that are essential to the conservation of the species and that may require special management considerations or protections. The Forest used the best available scientific information, considering updated critical habitat mapped by the USFWS (2014) and published maps for northwest Montana covering the Forest (Squires 2013). The estimate of the amount of lynx habitat on the Forest was developed using the procedures recommended in the Lynx Conservation Assessment and Strategy, and was reviewed by USFWS and Regional Office staff. Vegetation conditions in lynx habitat in the northern Rockies is ever-changing, but habitat maps are based upon biophysical characteristics such as habitat types capable of growing boreal forests and elevations associated with deep, fluffy snow. The current estimate, as well as data sources and methods used for the recent update, are summarized in chapter 3 and described in further detail in planning record exhibit V-24. Forestwide estimates are routinely field-verified and mapping is refined as part of project planning. Presence or absence of the critical habitat primary constituent element 1a-d are verified at the project level.

Wildlife habitat connectivity

Some commenters suggested that the plan revision should include a connectivity management area. The planning team considered this option but determined that connectivity is better addressed without having a specific management area. On forests such as the Flathead, connectivity of forest cover is not static. It is constantly changing due to a variety of factors such as stand-replacing wildfire, forest succession, insect and disease. All action alternatives include forest-wide and geographic area desired conditions for connectivity. All alternatives include desired conditions, standards and guidelines for RHCAs that would address connectivity. All alternatives include a guideline for highway crossings. Connectivity with respect to forest roads is addressed by desired conditions, standards and guidelines for grizzly bears and this will meet the needs of many other wildlife species. In addition, alternatives B, C, and D have different levels of emphasis on recommended wilderness, recreation, and timber production. These strategies provide for connectivity.

Citizen ReVision

The Citizen Revision proposal was considered and the issues identified in this comment are (1) largely included in the design of alternative C or (2) the no action alternative or (3) addressed in detail in the effects analysis in the DEIS so a specific alternative was not developed in detail.

Old growth

Some commenters suggested an alternative that maps and designates all existing and future old growth, as well as additional plan components for managing in existing and potential old growth. The planning team considered this option but determined that an alternative that maps old growth forest is not feasible, and that old growth is best addressed by forestwide plan components. Old growth forest can be determined only at the site specific level, and it is constantly changing due to natural disturbances and ecological processes (such as succession). All of the alternatives have plan components that provide for protection and enhancement of old growth forest.Draft forest plan desired conditions promote an increasing trend in the amount and patch size of old growth, as well as for very large tree size classes. Standards and guidelines protect existing old growth, support the development of future old growth, and provide for components of forest structure associated with old growth (such as very large snags and down wood). See the vegetation section of chapter 3 for further greater details.

Airstrips

Suitability determinations for airstrips are included in the alternative D. An alternative for additional airstrips was not developed in detail as the site specificity of this comment is outside the scope of plan revision and requires site-specific analysis at the project level.

Varying additional standards and guidelines

Commenters requested additional guidelines or standards proposed in the plan, or to increase or decrease the use of standards to minimize or increase flexibility and resource protection during plan implementation. The IDT carefully considered the suggested changes to standards and guidelines and have modified the draft forest plan where appropriate. See summary of changes to modified draft forest plan under alternative B and in the draft forest plan. Increased or decreased flexibility and resource protection is largely reflected by the 4 alternatives being analyzed in detail. The four alternatives reflect varying levels of standards and guidelines and specifically, compared to alternative B, alternative C varies standards and guidelines for grizzly bear and recommended wilderness which were the predominant issues that were brought up in the scoping of the proposed action.

Additional eligible rivers

Other alternatives for eligible wild and scenic rivers included Montanans for Healthy Rivers 2014 report to the Northern Region that determined that 46 rivers on the Flathead National Forest should be eligible for inclusion into the National Wild and Scenic River System. Out of those 46 rivers they determined to be eligible, 10 rivers were already deemed eligible by the Flathead National Forest in 2004 process. The Flathead National Forest we went through an additional eligible wild and scenic rivers process on those 36 rivers and 10 additional rivers were determined by the forest to have outstandingly remarkable values and were determined to be eligible in the Proposed Action. In addition, scoping comments indicated other additional rivers as eligible and the revision team revisited the upper Swan River as an eligible river bringing the total number of eligible rivers to 21. Scoping comments to the proposed action wanted all rivers that were ranked a 3 as eligible rivers. Our eligible river process determined rivers that were ranked a 4 for outstandingly remarkable values were deemed eligible, not those rated a 3; therefore this alternative was not included in the analysis.

In addition, scoping comments requested that all rivers that support bull trout and westslope cutthroat trout populations should be eligible wild and scenic rivers. To evaluate the fish outstandingly remarkable value, the merits of fish population and habitat or a combination of these conditions were reviewed. The presence of bull trout, a federally listed threatened species, as well westslope cutthroat trout, a species of conservation concern are two measures we looked at for population. In addition habitat measures such as the watershed condition framework, connectivity and crucial habitat and habitat conditions were also considered. Three rivers were ranked a 4 for fish; when the region of comparison was considered the rest did not meet the criteria for a 4 and were not included as an eligible wild and scenic rivers.

Aquatic Habitat

Some commenters suggested that the Flathead National Forest retain Inland Native Fish Strategy (INFISH) in its entirety and expand riparian habitat conservation area widths, hereinafter “riparian management zones” or RMZs, to 300 ft. for all perennial streams to protect native fish while some commenters requested smaller riparian management zone widths. There is some debate amongst the scientific community as to the size of riparian management zone widths that is necessary to accomplish resource objectives, but the Flathead National Forest did not evaluate in detail any proposals to reduce RMZ widths. Monitoring on the forest has shown that INFISH has been effective in improving aquatic habitat conditions with riparian management zone widths of 300 ft. for fish bearing streams, 150 ft. for perennial streams, 100 ft. for intermittent streams in bull trout watersheds and 50 ft. for all other intermittent streams (see section 1.4.3). INFISH is fully maintained without modification in alternative A, the no action alternative. Direction in the draft revised plan increases RMZ widths compared to INFISH along mapped wetlands, ponds, and lakes to 300 feet (regardless of size) and all intermittent streams will have a 100 foot RMZ width, rather than 50 feet as allowed in some locations under INFISH. This change will enable us to ensure consistency with the Montana SMZ law on intermittent streams with slopes that are greater than 35% which, under the SMZ law, require a 100 foot wide SMZ, and to provide for the multiple ecological functions contributed by riparian areas. These functions include providing wildlife habitat and connectivity of habitat, as well as providing for stream habitat conditions such as pools and large wood. Reducing widths of riparian management zones has the potential to reduce the ability to protect and restore riparian and aquatic resources and provide wildlife habitat connectivity, therefore reducing RMZ widths was not evaluated in detail.

Plan desired future conditions and objectives should be unconstrained by budget

Several commenters requested that the plan components not be constrained by budget considerations. The FSH directives 1909.12 chapter 21.12 specifically states the Responsible Official shall base the plan components on likely budgets and other assumptions that are realistic as required by 36 CFR 219.1(g). The DEIS includes discussions of effects when comparing progress to meeting to desired conditions. Appendix 2 of the DEIS (timber analysis) displays vegetation treatments and timber outputs that are achieved under constrained and unconstrained budgets, to move towards desired vegetation conditions while complying with identified management objectives and limitations (constraints). Therefore an alternative was not developed and will not be analyzed in detail.

2.7 Comparison of Alternatives

The following tables compare alternatives by a summary of management area allocations and effects by selected indicators for the issues used for alternative development. Refer to Table 3 for a crosswalk of the management areas in the existing plan (Alternative A) to those in the revised plan. Chapter 3 presents a detailed description of the effects of the alternatives.

Table 4 compares alternatives by management area allocation and indicates only one management area designation for each acre based upon an established hierarchy. Lands with dual (overlapping) or multiple management area designations are managed in accordance with Management Area assignment but must comply with the most restrictive plan direction.

In instances where management area allocations over-lap, e.g. an area that is MA1b recommended wilderness may also be 4a, a research natural area, then the acres were calculated based upon the following hierarchy:

1. Designated Wilderness (MA 1a)
2. Designated Wild and Scenic Rivers (MA 2a)
3. Recommended Wilderness (MA 1b)
4. Research Natural Areas (MA 4a)
5. Eligible Wild and Scenic Rivers (MA 2b)
6. Experimental and Demonstration Forests (MA 4b)
7. Special Areas (MA 3)

Table 4. Comparison of alternatives by management area acres[a] and percent allocation (single designation based upon established hierarchy)

Management Area	Alt A acres[b] (percent)	Alt B acres (percent)	Alt C acres (percent)	Alt D acres (percent)
1a Designated Wilderness	1,072,040 (45%)	1,072,040 (45%)	1,072,040 (45%)	1,072,040 (45%)
1b Recommended wilderness	98,388 (4%)	187,741 (8%)	506,919 (21%)	0
2a Designated wild and scenic rivers	17,605 (1%)	17,605 (1%)	17,605 (1%)	17,605 (1%)
2b Eligible wild and scenic rivers	0[c]	19,259 (1%)	15,701 (1%)	31,615 (1%)
3a Administrative areas	1,919 (<1%)	435 (<1%)	435 (<1%)	435 (<1%)
3b Special areas	226	1,579 (<1%)	1,579 (<1%)	14,787 (1%)
4a Research natural areas	9870 (<1%)	7,820 (<1%)	2,423 (<1%)	8,544 (<1%)
4b Experimental and demonstration forests	6,602 (<1%)[d]	11,544 (<1%)	11,544 (<1%)	11,544 (<1%)

5a Backcountry non-motorized year-round	--	156,104 (7%)	61,052 (3%)	291,071 (12%)
5b Backcountry motorized year-round, wheeled vehicle use only on designated routes/areas	--	50,374 (2%)	441 (<1%)	50,365 (2%)
5c Backcountry: motorized over-snow vehicle use	--	99,196 (4%)	73,426 (3%)	117,650 (5%)
5d Backcountry: wheeled motorized vehicle use only on designated routes/areas	--	9,855 (<1%)	0	9,855 (<1%)
5a-d Backcountry Total	401,018 (17%)[e]	315,529 (13%)	134,919 (6%)	468,942 (20%)
6a General forest low	74,381 (3%)	119,944 (5%)	214,603 (9%)	116,657 (5%)
6b General forest medium	208,304 (9%)	437,617 (18%)	258,056 (11%)	292,939 (12%)
6c General forest high	496,898 (21%)	169,080 (7%)	125,946 (5%)	297,095 (12%)
6a-c General forest Total	779,583 (33%)	726,641 (30%)	598,605 (25%)	706,691 (30%)
7 Focused recreation areas	5,557 (<1%)[f]	32,615 (1%)	31,037 (1%)	60,903 (3%)
Total Forest Acres	2,392,807	2,392,807	2,392,807	2,392,807

a. Acres and percentage from GIS dataset. The official acres for NFS lands and wilderness areas can be found in the land area report, http://www.fs.fed.us/land/staff/lar-index.shtml .

b. Alternative A, the no-action alternative, is included even though it does not use the management areas shown in the draft forest plan. See table 3 for a crosswalk of the 1986 plan management areas to those used in the draft forest plan and the action alternatives.

c. Acres of eligible wild and scenic rivers in the existing plan are the same as in the action alternatives (see Table 5). However, they were not assigned a MA in the existing 1986 forest plan, and were not mapped for the DEIS.

d. Miller Creek Demonstration Forest (4942 acres) was not assigned a management area in the existing 1986 plan.

e. The existing plan does not differentiate backcountry areas like the action alternatives; thus all backcountry acres are combined.

f. There is no MA in the existing 1986 forest plan equivalent to Focused Recreation Areas. These acres are the Round Meadow and Essex cross country ski areas and the mapped developed recreation sites.

Table 5 compares the alternatives by *actual* acres in each management area. In some instances management area allocations over-lap, e.g. an area that is MA1b recommended wilderness may also be 4a, a research natural area. In this table allocation of acres are listed under all assigned management areas even if an over-lap occurs, in other words an actual accounting.

Table 5. Comparison of alternatives by actual acres and percent of management area allocation (areas with multiple management area designations are listed accordingly) [a]

Management Area	Alt A acres (percent)	Alt B acres (percent)	Alt C acres (percent)	Alt D acres (percent)
1a Designated Wilderness	1,072,040	1,072,040	1,072,040	1,072,040
1b Recommended wilderness	98,388	187,741	506,919	0
2a Designated wild and scenic rivers	42,174	42,174	42,174	42,174
2b Eligible wild and scenic rivers	78,106	78,106	78,106	78,106
3a Administrative areas	2341	489	489	489
3b Special areas	15,510[b]	2,508	2,508	17,792[c]
4a Research natural areas	9870	9,870	9,870	9,870
4b Experimental and demonstration forests	7,478[d]	12,420	12,420	12,420
5a Backcountry non-motorized year-round	--	156,104	61,052	291,071
5b Backcountry motorized year-round, wheeled vehicle use only on designated routes/areas	--	50,374	441	50,365

Management Area	Alt A acres (percent)	Alt B acres (percent)	Alt C acres (percent)	Alt D acres (percent)
5c Backcountry: motorized over-snow vehicle use	--	99,196	73,426	117,650
5d Backcountry: wheeled motorized vehicle use only on designated routes/areas	--	9,855	0	9,855
5a-d Backcountry **Total**	479,518	315,529	134,919	468,942
6a General forest low	77,500	119,944	214,603	116,657
6b General forest medium	209,553	437,617	258,056	292,939
6c General forest high	498,348	169,080	125,946	297,095
6a-c General forest **Total**	785,401	726,641	598,605	706,691
7 Focused recreation areas	5,655[e]	32,744	31,196	61,062

a. Acres and percentage from GIS dataset. The official acres for NFS lands and wilderness areas can be found in the land area report, http://www.fs.fed.us/land/staff/lar-index.shtml.
b. These acres include the Jewel Basin Hiking Area.
c. Additional acres as compared to the action alternatives are due to the MA 3b "special area" designation of the Jewel Basin Hiking Area, which is recommended wilderness in Alternative B and C.
d. Miller Creek Demonstration Forest was not assigned a management area in the existing 1986 plan.
e. There is no MA in the existing 1986 plan equivalent to Focused Recreation Areas. These acres represent the Round Meadow and Essex cross country ski areas and the mapped developed recreation sites.

Chapter 3. Affected Environment and Environmental Consequences

3.1 Introduction

This chapter presents the existing environment of the Flathead National Forest (hereinafter referred to as the "Forest") plan revision project area and the potential consequences to that environment that may be caused by implementing the alternatives described in chapter 2. Within each resource section, the boundaries of the area used for the resource analysis is disclosed. The discussions of resources and potential effects take advantage of existing information included in the Assessment, other planning documents, resource reports and related information, and other sources as indicated. Refer to appendix D of the draft forest plan for information about the use of best available scientific information. Where applicable, such information is briefly summarized and referenced to minimize duplication. In addition to the citations and appendices included in the Assessment, Revised Plan, and environmental impact statement, the planning record includes all additional information.

This draft environmental impact statement (EIS) is a programmatic document. It discloses the environmental consequences on a large scale, at the planning level. This is in contrast to analyses for site-specific projects. The draft EIS presents a programmatic action at a forest level of analysis but does not predict what will happen each time the standards and guidelines are implemented. Environmental consequences for individual, site-specific projects on the Forest are not described. The environmental effects of individual projects will depend on the implementation of each project, the environmental conditions at each project location, and the application of the standards and guidelines in each case.

The affected environment and environmental consequences discussions in this chapter allow a reasonable prediction of consequences on the Forest. However, this document does not describe every environmental process or condition.

In addition, the DEIS includes analyses prepared by qualified resource specialists for species previously identified as sensitive.

3.1.1 Relationship of revised forest plan and future climate

Climate has a major influence on the Flathead ecosystems. Climate is described by the long-term characteristics of precipitation, temperature, wind, snowfall, and other measures of weather that occur over a long period in a particular place. Global research indicates the world's climate is warming, and this has been ongoing for many decades. The trend is expected to continue into the future, which will influence the world and this nation's forests (Dale, et al. 2001; Barton 2002; Breashears and Allen 2002; IPCC 2007; Westerling and Bryant 2008; Running 2006; Littell, et al. 2009, Boisvenue and Running 2010; Hicke et al 2012). For this DEIS, we used a recent compilation of information on climate change and potential effects published for the Northern Region Adaptation Partnership (NRAP) by Halofsky et al. (NRAP 2015 *in press*), which is incorporated by reference and the source for most of the information in this section. These predictions represent the current state of knowledge.

Global climate models have been used to understand the nature of climate, and to project potential future climate. Different climate models project different rates of change in temperature and precipitation because they operate at different scales, have different climate sensitivities, and incorporate feedbacks differently. Projections from the global models have been downscaled to represent climate dynamics for smaller areas, such as the subregions encompassing the Forest Service Northern Region (see figure 1-05). Though there is little debate that atmospheric carbon dioxide is increasing and that this increase will cause major changes in climate (IPCC 2007), there is a great deal of uncertainty about the magnitude and rate of climate change (Roe and Baker 2007, Stainforth and others 2005), especially as projections are made at finer resolutions or for longer time periods (Knutti and Sedlacek 2013). Nevertheless, these model projections at smaller scales are able to provide information useful to resource managers.

The revised forest plan and DEIS incorporate models, plan components, and resource management strategies that are developed using our latest understanding of climate and potential changes into the future. Climate trends and projections summarized in NRAP that are important to the ecosystems of the Flathead are listed below (see NRAP 2015).

- Climatologically, the Flathead Forest sits at the boundary between warm, wet, maritime airflows from the Pacific Ocean, and cooler, drier airflows from Canada. The western wide of the Flathead (Salish Mountains GA) is within the Western subregion as summarized by NRAP, and the rest of the Forest is within the Central subregion. In mountainous regions such as the Flathead, climatic variability is strongly influenced by interactions with topography, elevation and aspect.
- Temperatures have increased across the region over the past century. In the western and central subregions respectively, the annual mean monthly minimum temperature increased by about 3.0 and 2.6 degrees F. annual mean monthly maximum increased by about 0.6 and 1.3 degrees F. During this same period, annual mean monthly precipitation increased slightly.
- By the year 2100, annual mean monthly minimum and maximum temperature is projected to increase up to 10 degrees F. in the western subregion and up to 12 degrees F. in the central subregion. These increases exceed observed 20th century year-to-year variability, generally by the 2040s.
- Cold extremes will decrease and heat extremes will increase, meaning fewer below-freezing days and a longer frost-free season.
- Models have much higher uncertainty about future precipitation than temperature, but projections for precipitation suggest a slight increase in the future. Variation in precipitation between years may increase. Seasonal precipitation is projected to be slightly wetter in winter and spring and at high elevations; slightly drier in summer and at low elevations.
- Changes in climate affecting mountain snowpack will have important hydrological implications (see Aquatics section of this EIS).

Effects associated with climate change for specific key ecosystem characteristics, wildlife or aquatic species are discussed in their respective sections throughout this EIS

3.1.2 Budget levels

The Forest's budget directly affects the level of activities and outputs that may occur as a result of forest plan implementation. Budgets are expected to remain flat or decrease in the future. Objectives were based on the assumption there would not be a significant increase to current budget levels. To analyze effects without consideration of expected budgets would be a misrepresentation of expected outcomes. The exception is the vegetation and timber resource sections. To display movement towards vegetation desired conditions and to develop the sustained yield limit, an unconstrained budget level was analyzed along with the constrained, current budget level.

3.1.3 Chapter 3 organization

Chapter 3 is divided into four major sections:

1. Physical and biological
2. Human uses, benefits, and designations of the Forest
3. Production of natural resources
4. Economic, social, and cultural environment

Physical and Biological

This section includes the following resources:

- Soil, Watershed, Aquatic Species and Riparian Ecosystems
- Vegetation—Terrestrial Ecosystems
- Carbon Sequestration
- Plant Species
- Non-native Invasive Plants
- Wildlife
- Fire and Fuels Management
- Air Quality

3.2 Soil, Watersheds, Riparian Areas, and Aquatic Species

3.2.1 Introduction

This section considers numerous physical and biological resources such as: soil productivity, water quality, native and non-native desirable species, and aquatic habitats. Managing for high quality soils, water, and soil hydrologic function is fundamental in maintaining and restoring watershed health. Soil is the primary medium for regulating the movement and storage of energy and water and for regulating cycles and availability of plant nutrients (ICBEMP 1997). The physical, chemical, and biological properties of soils determine biological productivity, hydrologic response, site stability, and ecosystem resiliency.

The diverse lithology, structure, and climate over time have resulted in a spatially complex pattern of landforms and soils across the forest that responds differently to management activities. Most management activities and natural processes, such as recent wildfires, affect soil resources to varied extents. Impacts or indicators of stress include: surface erosion, compaction, and nutrient loss through removal of coarse woody debris, high severity burns, flooding or landslides. These effects may be in the uplands or within streams. Soil effects or stresses are not always detrimental or long lasting. In order to maintain and where necessary restore the long term quality and productivity of the soil, detrimental impacts to the soil resource must be managed within tolerable limits.

The Forest Service commonly evaluates how proposed management activities meet the requirements of the Clean Water Act from a holistic perspective that considers land management activities occurring throughout the watershed and their effects on water quality and aquatic habitat integrity. The goal of the Clean Water Act is "to restore and maintain the chemical, physical, and biological integrity of the nation's water". Listings of waterbodies and development of total Maximum Daily Loads (TMDLs) under Section 303(d) of the Act are symptomatic of the effects from historical and some ongoing management activities. Maintaining healthy watersheds and restoration of degraded watersheds will contribute towards the de-listing of impaired waterbodies and to the survival and recovery of aquatic species.

Productivity of soil and vegetation, proximity to water, and the general attractiveness of riparian and aquatic systems continue to make these areas ideal for many land uses managed by the Forest Service. Conflicts between some human uses and the resources dependent on resilient riparian conditions may continue unless management provides for sufficient land use limitations and resource protection that maintain the disturbance processes and pathways associated with resilient riparian conditions (Reeves et al, 1995; Lee et al, 1997; Lake, 2000; Poff et al, 2011). It is the intent of Forest Plan revision to provide direction to minimize, if not resolve, these conflicts.

The variety of landscapes and associated aquatic ecosystems support an array of different aquatic, terrestrial, and botanical species. Population sizes and distribution of some species like bull trout have declined in some locations in recent decades with special protection granted under the Endangered Species Act (ESA). Across the range of bull trout, reasons for decline of some populations are many (Lee et al, 1997, Allendorf et al, 2001, Martinez et al, 2009), yet some populations of bull trout are increasing (High et al, 2008). Aquatic species viability is dependent upon maintaining an array of well-connected, habitat conditions. Past management activities have contributed to fragmentation and degradation of habitat for fish and other riparian-dependent species. Humans have caused major changes in habitat conditions through such activities as timber management, livestock grazing, road and facility construction, dams, recreation and introductions of non-native species. Future management activities have the potential for both additional impacts and restoration of these species and their habitats. For aquatic species, the analysis looks at how the management alternatives for Forest Plan revision either contribute to or mitigate common threats to factors of decline within forest service authority and capability of lands

Methodology

The approach used in this analysis is to take a programmatic look at the outcomes that may result from implementing the proposed management direction in each alternative at the subwatershed to basin scale over the life of the plan. For estimating the effects at the programmatic-Forest Plan level, the assumption has been made that the kinds of resource-management activities allowed under the prescriptions are reasonably foreseeable future actions to achieve the goals and objectives. However, the specific location, design, and extent of such activities are generally not known at the time plans are revised. The decisions are made on a site-specific (project-by-project) basis. Therefore, the discussions here refer to the potential for the effect to occur and are in many cases only estimates. The effects analyses are useful when comparing and evaluating alternatives, but is not intended to be applied directly to specific locations on the Forest.

The forest plan prescribes no specific activity in any specific area, potential spatial and temporal effects to water quality cannot be attributed to any specific watershed. Therefore, cumulative effects to water quality can only be described in terms of potential to generally affect trends on a subwatershed to basin scale. In other words, the cumulative effects of a program at the forest plan scale as opposed to the effects from a project at the project scale can only be discussed in terms of general programmatic tendencies either toward improved or declining water quality or fisheries habitat at no specific site.

Therefore, the potential cumulative effects from forest programs to water quality will generally be discussed at the forest level as well as Flathead Lake. The temporal scale for this analysis will be limited to the life of this plan, generally 10 to 15 years.

Watershed conservation practices and forest plan standards prescribe extensive measures to protect riparian function and minimize effects caused by active forest management (McDonald et al 2003; Thomas et al, 2006; Reeves et al, 2006; Reiter et al, 2009). If all applicable measures are implemented and if they are effective, adverse effects from any of the alternatives should be minimized. It is unlikely that plan components will prevent any effects from occurring for each and every action that we may implement on the forest. Therefore, alternatives that propose higher levels of activity for various resources pose greater inherent risks to aquatic and riparian resources. Broad-scale outcomes were qualitatively estimated for effects on hydrologic function and watershed processes for NFS lands within the project area.

Legal and Administrative Framework

Federal Law

Clean Water Act: The Federal Water Pollution Control Act, or Clean Water Act, is the principal law concerned with polluting activity in the nation's streams, lakes, and estuaries. Originally enacted in 1948, it has been revised by amendments in 1972 (P.L. 92-500) that gave the act its current form and spelled out ambitious programs for water quality improvements that are now being put in place by industries and cities. Congress refined these amendments in 1977 (P.L. 95-217) and 1981 (P.L. 97-117). The 1987 amendments added:

A new Section 319 to the act, under which States were required to develop and implement programs to control nonpoint sources of pollution, or rainfall runoff from farm and urban areas, as well as construction, forestry, and mining sites.

Section 303(d) of the Clean Water Act requires states to identify pollutant-impaired water segments and develop "total maximum daily loads" that set the maximum amount of pollution that a water body can receive without violating water quality standards.

A water quality classification of streams and lakes to show support of beneficial uses.

Anti-degradation policies that protect water quality and stream conditions in systems where existing conditions exceed standards.

The Federal Water Pollution Control Act, as amended – Direction intended to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Sections 303, 319, and 404 apply to forest management activities. Section 208 of the 1972 amendments specifically mandates identification and control of non-point source pollution resulting from silvicultural activities. There are five required elements:

1. Compliance with state and other federal pollution control rules.
2. No degradation of instream water quality needed to support designated uses.
3. Control of non-point source water pollution using conservation or "best management practices."
4. Federal agency leadership in controlling non-point sources pollution from managed lands.
5. Rigorous criteria for controlling discharge of pollutants into the nation's waters.

Organic Administration Act: States that the mission of national forests is to "…provide favorable conditions of water flow…"

Multiple-Use Sustained-Yield Act of 1960: Congress has affirmed the application of sustainability to the broad range of resources over which the USDA Forest Service has responsibility. The Multiple Use Standard Yield Act confirms the USDA Forest Service's authority to manage the national forests and grasslands, "for outdoor recreation, range, timber, watershed, and wildlife and fish purposes," (16 U.S.C. § 528), and does so without limiting the USDA Forest Service's broad discretion in determining the appropriate resource emphasis or levels of use of the lands of each national forest and grassland.

National Environmental Policy Act (NEPA) (1969): Requires analysis of projects to insure the anticipated effects upon all resources within the project area are considered prior to project implementation (40CFR1502.16).

Endangered Species Act (1973) as amended: Section 7(a) (1) supports biotic sustainability by requiring that, "All…federal agencies shall …utilize their authorities in furtherance of the purposes of this act by carrying out programs for the conservation of endangered species and threatened species…" Section 7(a) (2) of ESA includes direction that federal agencies, in consultation with the United States Fish and Wildlife Service, will not authorize, fund, or conduct actions that are likely to jeopardize the continued existence of any threatened or endangered species or result in the destruction or adverse modification of their critical habitat.

National Forest Management Act (NFMA) (1976): Directs the Forest Service to manage for a diversity of habitat to support viable populations (36CFR219.19). Regulations further state that the effects on these species and the reason for their choice as management indicator species need to be documented (36CFR219.19 (a) (1).

Sikes Act of September 16, 1960, (16 U.S.C. 670a) - Provides for carrying out wildlife and fish conservation programs on Federal lands including authority for cooperative State-Federal plans and authority to enter into agreements with States to collect fees to fund the programs identified in those plans.

The Safe Drinking Water Act Amendments of 1996 - Provides states with more resources and authority to enact the Safe Drinking Water Act of 1977. This amendment directs the state to identify source areas for public water supplies that serve at least 25 people or 15 connections at least 60 days a year.

Regulation and Policy

Forest Service Manual and Handbook Direction (Policy):

- Forest Service manuals and handbooks within the 2500 file code designation contain direction for soil and watershed management.
- Forest Service manuals and handbooks within the 2600 file code designation contain direction on species and habitat management that supports recovery of listed species and maintenance of viable populations on NFS lands.

Region-wide Direction:

- FSH 2509.22 – Soil and Water Conservation Practices Handbook: To develop site specific soil and water conservation practices for use on National Forest system lands in R-1 and R-4 to comply with direction in the Clean Water Act.

Executive Orders

Executive Order 11988: Directs federal agencies take action on federal lands to avoid, to the extent possible, the long-and short-term adverse impacts associated with the occupancy and modification of floodplains. Agencies are required to avoid the direct or indirect support of development on floodplains whenever there are reasonable alternatives and evaluate the potential effects of any proposed action on floodplains.

Executive Order 11990, as amended: Requires federal agencies exercising statutory authority and leadership over federal lands to avoid to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands. Where practicable, direct or indirect support of new construction in wetlands must be avoided. Federal agencies are required to preserve and enhance the natural and beneficial values of wetlands.

Executive Order 12962 (June 7, 1995): Acknowledges the recreational value of aquatic biota by stating the objectives "to improve the quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased recreational fishing opportunities by: “(h) evaluating the effects of federally funded, permitted, or authorized actions on aquatic systems and recreational fisheries and document those effects relative to the purpose of this order”.

Executive Order 13112 - Directs federal agencies whose actions may affect the status of invasive species to (1) prevent the introduction of invasive species, (2) detect and respond rapidly to and control populations of such species in a cost effective and environmentally sound manner, as appropriations allow.

Other

Montana ARM 16.20.603 - This states that Best Management Practices (BMPs) are the foundation of water quality standards for the State of Montana. The Forest Service has agreed to follow BMPs in a Memorandum of Understanding with the state. Many BMPs are applied directly as mitigation at the project level. Implementing and effectiveness monitoring for BMPs are routinely conducted by contract administrators and during other implementation and annual monitoring events.

Montana ARM 17.30, sub-chapter 6 - Details water quality standards for the State of Montana. The Forest Service has primary responsibility to maintain these standards on lands under their jurisdiction in the state.

The Montana Natural Streambed and Land Preservation Act, also known as the 310 Law - Requires any person planning on working in or near a perennial stream on public or private lands to first obtain a permit from the state.

Federal Permits, Licenses, or Other Entitlements

EIS Only. When preparing an EIS, list all federal permits, licenses, and other entitlements which must be obtained in implementing the proposed action or alternatives. When preparing a DEIS and there is uncertainty whether a permit, license or other authorization for a proposed project will be necessary, specifically acknowledge that uncertainty in your report so it can be stated in the DEIS (40 CFR 1502.25 (b)).

Analysis area

The analysis area for the watersheds, soils, and aquatic species includes all lands within the outside boundary of the forest and the connected waterways to Flathead Lake (figure 1-06). Flathead Lake and the connected river system is also included because migratory bull trout and westslope cutthroat trout that emerge from Flathead National Forest streams move downstream to reach sexual maturity and then return to their natal streams to complete the spawning cycle. The river and lake are connected and native fish within the Middle and North Forks of the Flathead River depend on both for their survival.

The headwaters of the North Fork of the Flathead River are in British Columbia, where the river flows thirty-one miles through the province to the US Canada border. In the US, the North Fork continues south, bounded on the eastside by Glacier National Park and on the west by Flathead National Forest. The Middle Fork of the Flathead River has its headwaters in the Bob Marshall and Great Bear Wilderness areas. From its confluence with Bear Creek to where it joins with the North Fork Flathead River, the Middle Fork is bordered on the north by Glacier National Park and on the south by Flathead National Forest. Just ten miles south of the confluence of the North and Middle Forks, the South Fork Flathead River enters after leaving Hungry Horse Dam. The headwaters of the South Fork are in the Bob Marshall Wilderness. The North, Middle, and South Forks of the Flathead River have a combined drainage area of 4,464 square miles and an average annual discharge of 9,699 cubic feet per second, as measured at Columbia Falls (USGS 2002).

Between Columbia Falls and Kalispell, Montana, the mainstem of the Flathead River flows through the Flathead Valley on its way to Flathead Lake. Two major tributaries—the Stillwater and Whitefish Rivers—enter it here. They drain the valley floor and low elevation mountain ranges of the northwestern part of the subbasin, where ownership is mostly private but includes both Flathead National Forest and State lands. The Whitefish River joins the Stillwater River about 3 miles before its confluence with the Flathead River, roughly 22 miles upstream of Flathead Lake.

Flathead Lake is the largest lake, in terms of surface area, of any natural freshwater lake in the western US, and is one of the 300 largest lakes in the world. It covers 126,000 acres, has a mean depth of 165 feet, and a maximum depth of 370 feet. The Flathead Indian Reservation, where the Confederated Salish and Kootenai Tribes (CSKT) are the primary landowner, encompasses the south half of the lake. The Swan River enters the lake just north of the Reservation boundary at the town of Bigfork. The Swan River flows generally north for 66 miles from its headwaters in the Swan and Mission Mountain ranges. The drainage includes private, State and Flathead National Forest lands.

Affected environment introduction

The aquatic systems in the inland northwest evolved over millions of years under the influence of many geologic forces and processes. The present character and resiliency of the systems, climate, and geological processes have evolved following the last ice age, approximately 10,000 years ago. Since then the aquatic systems have been subject to a wide array of disturbances and events. These disturbances have often been intense and cyclic in nature. The watersheds and their dependent resources have evolved under this “pulse” disturbance regime so that they can effectively respond to those natural disturbances while sustaining their long-term functions, processes, and condition.

Around the beginning of the 20th century, the expansion of human populations began in the inland northwest along with the development of the land and resources to support those populations. This has resulted in many new human-caused disturbances to the watershed systems, and the pattern of many of those disturbances has tended to be a more sustained or “press” disturbance regime. A press disturbance forces an ecosystem to a different domain or set of conditions (Yount et Niemi, 1990; Reeves et al. 1995; Lake, 2000; Stanley et al, 2010). Many of those disturbances tend to mimic historic “natural” processes, but the frequency increases and intensity decreases creating a constant “press” condition. In some cases, the watershed systems that have been continually pressed have undergone regime changes (Stanley et al, 2010); creating stressors to aquatic dependent resources.

Human activities have altered stream channels by direct modification; such as channelization, removal of large woody debris, dams and diversions, historical log drives; and building infrastructure such as roads, railways, bridges, and culverts that have encroached on riparian areas and stream channels. Humans have also indirectly affected the incidence, frequency, and magnitude of disturbance events. This has affected inputs and outputs of sediment, water, and vegetation. These factors have combined to cause changes in channel conditions throughout many parts of the Forest resulting in aquatic and riparian habitat conditions different from those that existed prior to human development. Natural (primarily wildfire, floods, and landslides) combined with human-caused (timber harvest, fire suppression, road construction, mining, dams, introduction of non-native species, recreation, grazing, altered food web,) disturbances over the last century have led to changes in the physical watersheds and in the fish and amphibians dependent on them (Lee et al. 1997, Poff et al 2011, ISAB 2011a, ISAB 2011b, Naiman et al, 2012, Naiman 2013, Rieman et al, 2015).

Roads can have some of the greatest effects to watersheds and aquatic biota. Roads can change the runoff characteristics of watersheds, increase erosion and alter sediment composition and delivery to streams, and alter channel morphology (Furniss et al. 1991, Gucinski et al, 2001; Grace and Clinton, 2007; Trobulek and Frissell 2000). These direct effects lead to changes in habitats for fish and amphibians. Although current BMPs for road construction are designed to minimize the effects to watersheds, many miles of road existing on the landscape were not built to these standards (Swift and Burns, 1999) or are placed in stored service. As a result, these roads either continue to affect watersheds through chronic erosion or are at risk for mass failure from undersized stream crossings or locations on sensitive land types. Due to the glaciated nature of our forest from the Flathead Lobe of the Cordilleran ice sheet, many of our valleys are U shaped which allows for road locations on old floodplain terraces rather than along streams which is often the case in southwest Montana. Locating roads away from streams undoubtedly reduces sediment delivery into streams.

3.2.2 Soil affected environment

The Forest has a wide diversity of soil types from the minimally-developed, nutrient poor soil and rock outcrop complexes of the steep mountain slopes and ridges to the deep, fertile soils of the lower valleys. Steep terrain prone to intermittent surface movement combined with recent ablation of glaciers have limited soil development. Cool temperatures shorten the growing season to 140 days in the high country. A growing season of as much as 210 days, and gentle topography provide favorable conditions for soil development and forest production in the lower elevations of the forest.

Soils developed on Mesoproterozoic Belt Supergroup, a sequence of sedimentary and metasedimentary rocks, primarily mudstones, or Belt derived material deposited by glaciers, streams and wind. Soils tend to be skeletal and have varying degrees of ash/loess surface soil that increases the soil ability to hold water. Soil depth follows geomorphology closely; deep soils form on concave slopes and valleys, and shallow soils form on ridges.

Valley soils developed on material deposited by glaciers, glacial streams and modern streams and rivers. They vary therein by more subtle geomorphic form, including outwash fans, moraines, lacustrine and stream-laid terraces, and contemporary river floodplains. The outwash fans and moraines promote very rocky soils with a thick root-tight layer of mixed ash/loess material. The lacustrine terraces have much finer textures that can shift vegetation habitat type. An ash/loess topsoil heighten productivity since glacial deposits have inherent excessive drainage.

3.2.3 Watersheds affected environment

Watersheds and their ecological condition have been an increasingly important focus for public land managers in last two decades (Northwest Forest Plan, USDA and USDI, 1994; INFISH 1995; PACFISH 1995; Thomas et al, 2006; Reeves et al, 2006; Esselmen et al 2011). Congress has also had increasing interest in watershed condition, especially when it comes to investment in watershed restoration (USDA, 2011a). Nationally, the Forest Service introduced two general technical reports to respond to Congress' interest in 2011. The reports are the Watershed Classification Framework (FS-977, USDA 2011a) and the Watershed Condition Classification Technical Guide (FS-978, USDA 2011b). The Watershed Condition Framework (WCF) and the Watershed Condition Classification Technical Guide (WCF) were developed in tandem to provide a consistent method to categorize how the Forest Service identifies the condition of sub-watersheds as well as providing guidance to help national forests select Priority Watersheds.

The WCF establishes a nationally consistent reconnaissance-level approach for classifying watershed condition, using a comprehensive set of 12 indicators that are surrogate variables representing the underlying ecological, hydrological, and geomorphic functions and processes that affect watershed condition. Primary emphasis is on aquatic and terrestrial processes and conditions that Forest Service management activities can influence. The indicators use data when available and professional opinion when data is not available. The approach is designed to foster integrated ecosystem-based watershed assessments; provide guidance to programs of work in watersheds that have been identified for restoration; enhance communication and coordination with external agencies and partners; and improve national-scale reporting and monitoring of program accomplishments. The WCF provides the Forest Service with an outcome-based performance measure for documenting improvement to watershed condition at forest, regional, and national scales (USDA 2011).

Watershed condition classification ultimately ranks watersheds in one of three discrete categories (or classes) that reflect the level of watershed health or integrity. In our usage, we consider watershed health and integrity as conceptually the same (Regier 1993): watersheds with high integrity are in an unimpaired condition in which ecosystems show little or no influence from human actions (Lackey 2001).

The FSM classification defines watershed condition in terms of “geomorphic, hydrologic and biotic integrity” relative to “potential natural condition.” In this context, integrity relates directly to functionality. We define geomorphic functionality or integrity in terms of attributes such as slope stability, soil erosion, channel morphology, and other upslope, riparian, and aquatic habitat characteristics. Hydrologic functionality or integrity relates primarily to flow, sediment, and water-quality attributes. Biological functionality or integrity is defined by the characteristics that influence the diversity and abundance of aquatic species, terrestrial vegetation, and soil productivity. In each case, integrity is evaluated in the context of the natural disturbance regime, geoclimatic setting, and other important factors within the context of a watershed. The definition encompasses both aquatic and terrestrial components because water quality and aquatic habitat are inseparably related to the integrity and, therefore, the functionality of upland and riparian areas within a watershed.

Within this context, the three watershed condition classes are directly related to the degree or level of watershed functionality or integrity:

- Class 1 = functioning properly
- Class 2 = functioning at risk
- Class 3 = impaired function

The Watershed Condition Framework (USDA 2011) characterizes a watershed in good condition as one that is functioning in a manner similar to natural wildland conditions (Karr and Chu 1999, Lackey 2001). A watershed is considered to be functioning properly if the physical attributes are adequate to maintain or improve biological integrity. This consideration implies that a Class 1 watershed that is functioning properly has minimal undesirable human impact on its natural, physical, or biological processes, and it is resilient and able to recover to the desired condition when disturbed by large natural disturbances or land management activities (Yount and Neimi 1990). By contrast, a Class 3 watershed has impaired function because some physical, hydrological, or biological threshold has been exceeded. Substantial changes to the factors that caused the degraded state are commonly needed to return the watershed to a properly functioning condition.

The primary hydrologic unit upon which watershed condition has been assessed is the 6th-level hydrologic unit (subwatershed). To evaluate baseline watershed conditions across the analysis area, a watershed condition rating was determined for each subwatershed. This characterization estimated the existing condition based on physical characteristics (e.g., hydrologic, geomorphic, landscape, topographic, vegetative cover, and aquatic habitat) and human caused disturbances (e.g., road construction and vegetative treatments).

The Forest completed the Watershed Condition Framework in 2011 following the guidelines set forth in the Watershed Condition Classification Technical Guide (Potyondy and Geier 2010). Specialists used GIS derived data such as road and trail density within RMZs, barrier locations, insect and disease, etc. to classify conditions while using the guide as a template. Best professional judgement was also used as stated in the guide. The Watershed Condition Classification for the Forest can be found in the project file and summarizes the information used in a spreadsheet for our determinations.

The Forest completed the first round of Watershed Condition Classification in summer 2011. The Forest identified 5 Class 2 watersheds (Middle Logan Creek, Meadow Creek, Beaver Creek, Jim Creek, and Cold Creek) and 176 Class 1 watersheds. While there are many sub-watersheds that have had extensive human use, there are some important geophysical characteristics that help to explain why so many watersheds are considered Class I and no watersheds were ranked as Class 3 on the Flathead National Forest. Parent geology in the project area is mostly composed of the relatively hard Belt Supergroup that does not erode as easily as other kinds of rock (Sugden and Woods, 2007). Further, Sugden and Woods note that geology in the plan areas has low erodibility and low rainfall. These characteristics reduce the amount of human caused sedimentation occurring in streams, which if present and widespread would more negatively influence some components that help make up WCC scores.

When compared to other watersheds on national forests across the country, the Flathead also does not face the level of urbanization pressure faced by Forests with large urban centers bordering and sometimes intermixed with federal lands. Urbanization brings increasing levels of nutrient contamination and increasing percentages of hardened surfaces, both of which negatively affect watersheds in myriad ways (Wang and Kenehl, 2003; Meyer et al, 2005).

Watersheds that support bull are an emphasis for restoration using the Priority Watershed designation under WCF as well as when designated under Conservation Watershed Network. Bull trout are a listed species and a goal under the Bull Trout Conservation Strategy and the Recovery Unit Implementation Plan is to improve habitat conditions. Of these 5 Class 2 watersheds, bull trout are found in Jim and Cold creeks and they would rate out as the highest priority for restoration of the condition class 2 watersheds. Bull trout were never present historically in Logan, Meadow and Beaver creeks.

Stream channels

Streams carry water, sediment, dissolved minerals, and organic material derived from hillsides and their vegetation cover. The shape and character of stream channels constantly and sensitively adjust to the flow of this material by adopting distinctive patterns such as pools-and-riffles, meanders, and step-pools. The vast array of physical channel characteristics combined with energy and material flow, provide diverse habitats for a wide array of aquatic organisms.

Varied topography coupled with the irregular occurrences of channel-affecting processes and disturbance events such as fire, debris flows, landslides, drought, and floods, result in a mosaic of river and stream conditions that are dynamic in space and time under natural conditions. The primary consequence of most disturbances is to directly or indirectly provide large pulses of sediment and wood into stream systems. As a result, most streams and rivers undergo cycles of channel change on timescales ranging from years to hundreds-of-years in response to episodic inputs of wood and sediment. The types of disturbance, that affect the morphology of a particular channel depends on watershed characteristics, size, and position of the stream within the watershed. Many aquatic and riparian plant and animal species have evolved in concert with stream channels. They develop traits, life-history adaptations, and propagation strategies that allow persistence and success within dynamic landscapes.

Human uses have altered some stream channels in the last century. Stream channels have changed as a result of channelization, wood removal, road building, logging, splash dams, and indirectly by altering the natural incidence, frequency, and magnitude of disturbance events such as wildfire. Some characteristics of channels commonly measured to help identify changes caused by management include include frequency and depth of large pools, the width-depth ratio of stream channels, and the percent of fine sediment contained in substrate (Al-Chokachy et al, 2010) Low gradient stream channels show the most response to land management activities. Lower pool frequencies and higher fine sediment concentrations are most obvious in watersheds with higher road densities such as the Swan Island Unit and Tally Lake Ranger District. These findings are consistent with observations that indicate past road construction/maintenance, grazing, and timber harvest practices altered sediment delivery and routing, and potentially other habitat components, which in turn has led to fewer pools, higher fine sediment content, and stream aggradation.

Consequently, watersheds, stream channels, and aquatic habitats in some locations on forest are now subject to continued compounding effects of watershed disturbance. This contrasts with a more pulse-like pattern of disturbance under which most streams and associated species evolved. Consequently, some stream channels are less than optimal for aquatic and riparian-dependent species, which evolved in environments that had many more high-quality habitat areas spread across the landscape. These conditions are more prevalent on the Swan Island Unit and Tally Lake Ranger District.

The most comprehensive and consistent data set on stream channel conditions is provided by the PIBO monitoring program. This program is a highly organized monitoring effort that spans the Interior Columbia River Basin. Monitoring began on the Forest began in 2001 and includes 70 sites in reference and managed watersheds. This program allows the evaluation of status and trends and comparison of reference and managed conditions. An analysis of stream habitat conditions using the PIBO data can be found in the project files. Another good metric to describe channel conditions is percent fine sediment (material <6.35 mm) measured by McNeil core samples. Montana Department Fish, Wildlife, and Parks have been monitoring percent fine sediment on forest streams since 1980 and that data can be found in the assessment.

Forest-scale analysis of PIBO data has determined habitat attributes in reference and managed streams are departed for median particle size, percent fines, and bank angle. Median particle sizes and percent fines data indicate that fine sediment levels in managed streams are statistically different and slightly higher than reference streams on average when considered for the entire forest. The most degraded sediment conditions occur on the Swan and Tally Lake Ranger Districts. Bank angles are actually smaller in managed streams compared to reference (Kendall 2014). In non-forested ecosystems, smaller bank angles indicate more favorable habitat conditions. Bank angles may create more favorable habitat on forested streams on the Flathead as well, but there is some uncertainty regarding this assumption.

Taking a closer look at the data reveals that percent fines are highest in streams that primarily support brook trout.

Water quality

Water quality is regulated under the authority of the Clean Water Act, and Montana assess the waters within their jurisdiction and identify stream segments and other water bodies whose water quality is “impaired” or generally not meeting water quality standards for beneficial uses.

Individual stream segments, lakes, and other water bodies have been listed as "Water Quality Limited Segments" (i.e., "impaired") by the state of Montana (Montana DEQ 2014) and are described in subsection 303(d) of the Clean Water Act as waters that do not meet state standards; a broad term that includes water quality criteria, designated uses, and anti-degradation policies. The dominant pollutant currently affecting "impaired" water bodies on the forest is sediment.

The Montana Department of Environmental Quality (MDEQ) develops Total Maximum Daily Loads (TMDLs) and submits them to the U.S. Environmental Protection Agency (EPA) for approval. The Montana Water Quality Act requires DEQ to develop TMDLs for streams and lakes that do not meet, or are not expected to meet, Montana water quality standards. A TMDL is the maximum amount of a pollutant a waterbody can receive and still meet water quality standards. TMDLs provide an approach to improve water quality so that streams and lakes can support and maintain their state-designated beneficial uses.

An excellent example of the TMDL process is Big Creek which was previously listed as impaired for sediment in 1996 because historic road building and timber harvesting activities in the Big Creek watershed led to accelerated soil erosion and a substantial increase in the amount of fine sediment delivered to Big Creek. Frequent monitoring by MT Fish, Wildlife, and Parks revealed degraded fish habitat in Big Creek due to increases in the amount of sand and silt in bull trout spawning habitat. Spurred by this listing, the Flathead National Forest collaborated with MDEQ to complete the *Watershed Restoration Plan for Big Creek, North Fork of the Flathead River* (United States Forest Service, 2003) which established a TMDL for sediment through its approval by the United States Environmental Protection Agency (EPA) on May 9, 2003. The state concluded during subsequent evaluations that subsurface fine sediment is no longer limiting the fishery and aquatic life beneficial uses. As a result, MDEQ removed Big Creek from the state's 2012 list of impaired waters for sediment and was the first water body in Montana to have undergone the full water quality restoration process and be removed from the MDEQ's list of sediment-impaired waters. Although Big Creek remains listed for alteration in-stream-side or littoral vegetative covers.

Restoration practices in Big Creek included decommissioning 60.6 miles of forest logging roads, removing 47 culverts and replacing 19, improving 89 miles of roads to decrease storm water runoff; revegetating 25 acres of eroding uplands, and working with Montana Fish, Wildlife and Parks to improve the amount of large wood in headwater streams that feed Big Creek.

An indication of the improving stream habitat and water quality trend can be intuited and partially explained from the TMDL and 303(d) listing process. In 1996, the year after the implementation of INFISH, there were 22 streams on the forest that were listed as impaired due to siltation. During the TMDL development for streams on the forest from 2004 to 2014 no TMDL was required for 17 of those streams because data collected to support TMDL development indicated that they were no longer impaired for sediment and were removed from the 303(d) list without a required TMDL (MDEQ 2014). In other words sediment which was a leading factor towards impairment was no longer impacting beneficial uses. The implementation of INFISH direction along with BMPs, reduction of road construction and a reduction of timber harvest along streams likely helped reduce sediment delivery.

There are approximately 8,177 miles of stream within the forest administrative boundary. DEQ has assessed about 5.2 % or 422 miles of those streams (MTDEQ 2016, http://deq.mt.gov/Water/WQPB/cwaic). The break down from of categories are:

- Category 1- 42% of the streams assessed were found to be fully supportive of all beneficial uses.
- Category 2- 32 % of the streams assessed had information that showed some, but not all, of the beneficial uses are supported.
- Category 4A- 18 % of the streams assessed had TMDLs required and they have already been completed.

- Category 4C- 8% of the streams assessed are impaired in pollution categories such as dewatering or habitat modifications, thus a TMDL is not required.

The results are not indicative of actual water quality as DEQ focuses their assessment on impaired water and most pf the healthy stream miles have not been assessed and entered into Montana's Waterbody System (MT DEQ 1998).

On the Flathead National Forest, MDEQ determined that sediment continues to impair aquatic life in Logan, Sheppard, Coal, Goat, and Jim creeks and MDEQ provided sediment TMDLs for those waterbody segments. Therefore, TMDLs have been developed for all streams on forest where required. Fish Creek is a recent example of a stream that was on the 1996 303(d) list and continuing through the 2014 303(d) list for sediment impairment, but data collected by MDEQ to support TMDL development in 2014 indicated that it is no longer impaired for sediment and will be removed from the 303(d) list (MDEQ 2014). The forest is committed to removing the remaining the streams from the 303 (d) list similar to efforts put forth in Big Creek.

For the five streams with sediment TMDLs, excess sediment may be limiting their ability to support aquatic life. Water quality restoration goals for sediment were established on the basis of fine sediment levels in trout spawning areas and aquatic insect habitat, stream morphology and available in-stream habitat as it related to the effects of sediment, and the stability of streambanks. DEQ believes that once these water quality goals are met, all water uses currently affected by sediment will be restored. DEQ's water quality assessment methods for sediment impairment are designed to evaluate the most sensitive use, thus ensuring protection of all designated uses. For streams in western Montana, the most sensitive use assessed for sediment is aquatic life. Table 6 lists the impaired waterbodies on forest and the cause and source of impairment from the 2014 303(d) list.

Table 6. Impaired waterbodies on Forest, and cause and source of impairment from the 2014 303(d) list

Waterbody	Cause of impairment	Sources of impairment
Big Creek*	Alteration in stream-side or littoral vegetative covers	Forest Roads (Road Construction and Use) Streambank Modifications/destablization
Coal Creek	Alteration in stream-side or littoral vegetative covers Sedimentation/Siltation	Forest Roads (Road Construction and Use) Silviculture Harvesting
SF Flathead River- HH Dam to mouth	Other flow regime alterations	Hungry Horse Dam
Logan Creek	Other flow regime alterations Physical substrate habitat alterations Sedimentation/Siltation	Forest Roads (Road Construction and Use) Silviculture Activities Streambank Modifications/destablization
Sinclair Creek	Low flow alterations	Agriculture Streambank Modifications/destablization
Sheppard Creek	Alteration in stream-side or littoral vegetative covers Sedimentation/Siltation	Crop Production (Crop Land or Dry Land) Forest Roads (Road Construction and Use) Grazing in Riparian or Shoreline Zones Silviculture Harvesting
Jim Creek	Sedimentation/Siltation	Silviculture Harvesting

Waterbody	Cause of impairment	Sources of impairment
Goat Creek	Total Suspended Solids (TSS)	Highways, Roads, Bridges, Infrastructure (New Construction) Silviculture Harvesting

*Big Creek was removed from the list for “Alteration in stream-side or littoral vegetative covers” in April 2016.

Flathead Lake lies downstream about 25 miles from the forest boundary on the Flathead River and about 8 miles downstream from the forest boundary on the Swan River. Aquatic life was first listed as being impaired in Flathead Lake because of sediment in 1996, and the lake was still identified as impaired for sedimentation/siltation in 2014 (Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau, 2014). The last formal assessment by MDEQ was completed in 2000. Along with sediment, the lake is also listed as impaired by polychlorinated biphenyls (PCBs), mercury, Total Nitrogen (TN), and Total Phosphorus (TP). To address some of these listings, nutrient Total Maximum Daily Loads (TMDLs) for both TN and TP were completed and approved for Flathead Lake in 2001(Montana Department of Environmental Quality, 2001). In the summer of 2014, the Water Quality Planning Bureau of the Planning, Prevention and Assistance Division of Montana DEQ re-assessed the existing Flathead Lake sediment impairment listing and used a weight of evidence reassessment to determine that Flathead Lake is not impaired for sediment and that beneficial uses in Flathead Lake are not currently threatened or impaired by sediment (Montana Department of Environmental Quality, 2014).

Holland, Lindbergh, and Ashley lakes are within the forest administrative boundary and have been classified as category 3- Insufficient or no data available to determine whether or not any designated use is attained. Four waterbodies that are below our forest boundary, Whitefish Lake (2004), Swan Lake (2004), Haskill Creek (2014) and the Stillwater River (2014) also have sediment TMDLs that have been developed.

Municipal water supply

Haskill Creek originates northeast of the City of Whitefish at the Whitefish Mountain Resort, and it flows approximately 11 miles to its confluence with the Whitefish River. Haskill Creek has three main tributaries, First Creek, Second Creek, and Third Creek, all of which comprise Haskill Basin. Second and Third Creeks are the primary source of the municipal water supply for the City of Whitefish. The entire Haskill Basin Watershed covers approximately 8,200 acres, of which 53% is privately owned, 41% is owned by the U.S. Forest Service, and 6% is owned by the State of Montana. In recent years, sediment production from point and non-point sources has increased throughout the Haskill Basin due to a variety of anthropogenic modifications, including land cover disturbance, physical stream straightening, and floodplain encroachment, as well as residential and commercial developments.

The proposed protection of land and water in Whitefish’s Haskill Basin has been ranked as the top priority for the U.S. Forest Service’s Forest Legacy Program (USFS 2013).

Groundwater

Groundwater-dependent ecosystems are communities of plants, animals, and other organisms that depend on access to or discharge of groundwater, such as springs, fens, seeps, areas of shallow groundwater, cave and karst systems, hyporheic and hypolentic zones, and groundwater-fed lakes, streams, and wetlands.

Ground water is an important resource in Montana and it will likely become more important in the future as the state's population and industries grow. More than half of Montanans depend on groundwater for their primary water supply. According to the Natural Resource Information Service, groundwater provides 94 percent of Montana's rural domestic-water supply and 39 percent of the public-water supply. Montana uses over 188 million gallons of groundwater per day for domestic use, public water supplies, irrigation, livestock and industry (USGS, Estimated Use of Water in the United States in 2000). Water generated in the mountains of the forest is an important source of recharge for valley aquifers and is therefore an important forest product.

Because of limited supply and lack of development opportunities, beneficial use of forest groundwater is generally low. Consumption is limited to special- use permits and Forest Service campgrounds or administrative sites with domestic wells. Off-forest, groundwater is used extensively for pump irrigation and drinking water wells in the valley. There are very few natural sources of ground-water contamination. Most threats to groundwater quality are linked directly, or indirectly, to a variety of human activities. Ground water can be contaminated by; leaks from underground fuel storage tanks and pipes, leaks from cemeteries, leaks from waste disposal sites such as landfills, seepage from septic systems and cess pools, accidental spills from truck and train mishaps, saline runoff from roads and highways, seepage from animal feed lots, irrigation return flow, leaching and seepage from mine spoils and tailings, and improper operation of injection wells. None of these activities occur on the forest, although hauling of coal from North Dakota on railcars along the Middle Fork Flathead River remains a concern.

Bull trout are highly dependent on hyporheic exchange and groundwater areas that influence spawning and winter habitat conditions. Weekes et al. (2012) outlines how such areas of strong groundwater influence are determined by long-term geologic features, including moraines left by retreating glaciers earlier in the Quaternary, more recent or contemporary rock glaciers, rock talus, and ancient landslides and debris flow events. The unifying feature of these geomorphic controls on groundwater is that they are permanent landforms with high permeability and water storage capacity whose effects on hydrology last far beyond their initial creation by glacial or colluvial deposition. Bull trout can be seen as ecological specialists where spawning and early rearing is highly depended on the stream habitats these geologic features create, where flow and thermal conditions are relatively invariant in the face of weather events and climate shifts. The direct reliance of bull trout on groundwater influenced waters where temperature changes are not accurately predicted by presently available climate hydrology change models such as the Climate Shield model (Isaak et al. 2015) may question the utility of the models in our area.

There are four major sources of groundwater influence and buffering of streams that support bull trout spawning and early rearing: 1) Deep, long-residence groundwater associated with bedrock fracturing and other geologic structures; 2) shallow slope aquifers, commonly associated with ancient Quaternary glacial or periglacial deposits of sediment and soil that are recharged by wetland complexes and associated upland processes, or in some cases by lakes deep enough to retain cold water at depth, with water stored over time frames of months to a few years percolating subsurface to recharge adjacent or connected streams; 3) delayed ice melt, storage, and percolation of runoff through coarse---textured colluvial (periglacial and landslide) deposits in mountain tributaries; 4) shallow aquifers associated with hyporheic entrainment of stream and riverine surface waters in alluvial deposits, and discharge back into those surface waters. Recharge of alluvial aquifers by winter and spring snowmelt, rain-on-snow, or rainfall results in storage of cold water for periods ranging from weeks to months, lagged discharge of stored cold water back into surface waters during the hottest summer and early fall months (Weekes et al. 2015).

3.2.4 Riparian areas affected environment

In general terms, riparian areas are lands at the interface between land and a river or stream and wetlands are lands that are saturated with water all year or for varying periods of time during the year. Both encompass unique and diverse vegetation types that are closely associated with lakes, streams, ponds, marshes, swamps, bogs, fens and other areas of high or fluctuating water tables. Although they may occupy a small percentage of the landscape, riparian areas provide important habitat for many terrestrial and aquatic species, including connectivity of habitat from headwaters to downstream areas.

The vegetation composition and structure, and the pattern of the riparian and wetlands across the Forest are highly diverse. Plant communities may be dominated by shrubs with few trees, or they may be forested. Riparian vegetation may be dominated by hardwood trees, particularly black cottonwood and paper birch, or coniferous species. Spruce and subalpine fir are most common, with grand fir and western redcedar on the warmer sites. Other species, such as Douglas-fir and larch, are also present in many riparian areas. Shrubs include alder, willows, red-osier dogwood, elderberry, buckthorn, thimbleberry, twinberry, and hawthorn. Forbs and grass-like plants that occupy these sites are quite diverse. The vegetative structure may include many decayed and dead trees, and multiple layers of vegetation that include submerged vegetation along open water margins, as well as plants that grow in conditions with variable amounts of soil saturation. Pattern of riparian and wetland ecosystems vary from relatively narrow strips of land along perennial and intermittent streams in deeply incised, steep mountain valleys, to marshes and adjacent wetlands within the wide valleys of the major river bottoms. They may be interconnected in a linear fashion down hillsides and in valleys; they may occur in clusters, or they may occur as isolated microsites in other ecosystems. They are widely distributed across the forest, occurring at all elevations.

Riparian ecosystems are equally important habitat to wildlife for feeding, drinking, cover, breeding season habitats, and habitat connectivity. They are often rich in bear foods such as skunk cabbage and other herbaceous plants with nutritious bulbs. Many wildlife species are associated with riparian ecological systems, including the Canada lynx, grizzly bear, common loon and fisher. Rocky sites behind waterfalls provide key breeding habitat for black swifts. A federally listed threatened plant, Howellia aquatilus, has been found in only one type of riparian pothole or wooded vernal pool in Montana and it occurs on the Forest.

Riparian management zones (RMZs)

RMZs are areas where riparian-dependent resources receive primary emphasis and management activities are subject to specific standards and guidelines. RMZs consist of upland and riparian vegetation adjacent to streams, wetlands and other bodies of water help maintain the integrity of aquatic ecosystems. Riparian processes maintain functions by (1) influencing the delivery of coarse sediment, organic matter and woody debris to streams; (2) providing root strength for channel stability; (3) shading the stream; and (4) protecting water quality. Fish and other aquatic life benefit greatly from riparian protection due to the processes mentioned. The riparian plant communities described above occur within RMZs. Most wildlife use riparian and/or aquatic habitats for at least some of their daily or seasonal needs. Due to their linear or clustered nature, RMZs function as important connectivity areas for numerous species of wildlife. The widespread distribution and pattern of RMZs on the forest provide extensive habitat connectivity for wildlife.

RMZs adjacent to wetlands and streams are defined as follows (FW-STD-RMZ-01):

Category 1 - Fish-bearing streams: RMZs consist of the stream and the area on either side of the stream extending from the edges of the active channel to the top of the inner gorge, or to the outer edges of the 100 year floodplain, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance (600 feet, including both sides of the stream channel), whichever is greatest.

Category 2 - Permanently flowing non-fish bearing streams: RMZs consist of the stream and the area on either side of the stream extending from the edges of the active channel to the top of the inner gorge, or to the outer edges of the riparian vegetation, or to a distance equal to the height on one site-potential tree, or 150 feet slope distance (300 feet, including both sides of the stream channel), whichever is greatest.

Category 3 - Ponds, lakes, reservoirs, and wetlands: RMZs consist of the body of water or wetland and the area to the outer edges of the riparian vegetation, or to the extent of the seasonally saturated soil, or to the distance of the height of one site-potential tree, or 300 feet slope distance from the edge of the maximum pool elevation of constructed ponds and reservoirs, or from the edge of the wetland, pond, or lake, whichever is greatest. This includes Howellia sites and fens. These category 3 RMZs are mapped and displayed in appendix B.

Category 4 - Seasonally flowing or intermittent streams and lands identified as landslide prone: This category includes features with high variability in size and site-specific characteristics. At a minimum, the RMZ must include: (1) the intermittent stream channel and the area to the top of the inner gorge; (2) the intermittent stream channel or wetland and the area to the outer edges of the riparian vegetation; (3) for Priority bull trout watersheds as identified in Appendix E, the area from the edges of the stream channel , wetland, or landslide prone terrain to a distance equal to the height of one site-potential tree, or 100 feet slope distance, whichever is greatest; or (4) for watersheds not identified as Priority watersheds, the area from the edges of the stream channel, wetland, or landslide prone terrain to a distance equal to the height of one-half site potential tree, or 50 feet slope distance, whichever is greater. RMZs have been identified and mapped (figure B-09) across the Flathead Forest, based on the criteria in categories 1 through 4 above, with the addition of riparian or wetlands types from other data sources. These sources include riparian landtype inventory and mapping conducted on the Forest; various Montana Natural Heritage Program data sets; data sets produced locally on the Flathead Forest and by Forest Service Region 1; and the national Hydrologic Database (accessed 2013).

There are about 427,320 acres of mapped RMZs on Forest lands, comprising approximately 18% of NF lands on the forest. RMZs occur within all management areas, and all RMZs are classified as not suitable for timber production. Approximately 20% of the total mapped RMZs occur within the boundaries of management areas suitable for timber production (e.g., MA 6b, 6c, portion of MA 4b and MA 7). These RMZ areas are excluded from calculations of suitable acres, (i. e timber harvest is not programmed within RMZs) conducted for the effects analysis on the timber resource (refer to Timber section of EIS).

During the past few decades, land managers have recognized the importance of riparian ecosystems in maintaining water quality, terrestrial habitat, and aquatic habitat. As a result, riparian conservation measures have been developed for federal, state, and private lands – helping to preserve and protect the integrity of the riparian and wetland habitats, as well as the water quality of associated water bodies. On NFS lands, site-specific standards and guidelines have been applied to RMZs, helping to provide connectivity and maintain composition, structure, and function.

3.2.5 Aquatic species affected environment

This analysis considers bull trout (*Salvelinus confluentus*) and westslope cutthroat trout (*Oncorhynchus clarki lewisi*) because these two species require colder and cleaner water and thus have stricter habitat requirements than other native fish in the plan area. Because of these two species strict habitat requirements, plan components developed for these two species will provide stream habitat conditions for other native aquatic organisms such as sculpins and tailed frogs. Other native species known to be present in the project area are mountain whitefish (*Prosopium williamsoni*), largescale sucker (*Catostomus macrocheilus),* longnose sucker *(Catostomus catostomus),* and sculpin (*Cottus sp.*) in riverine environments. Native species found in lakes include: Pygmy whitefish (*Prosopium coulterii),* Northern pikeminnow (*Ptychocheilus oregonensis),* Peamouth chub *(Mylocheilus caurinus),* and Redside shiner *(Richardsonius balteatus).* Tailed frogs (*Ascaphus montanus*), Long-toed Salamander (*Ambystoma macrodactylum*), Columbia Spotted Frog (*Rana luteiventris*), Pacific Treefrog (*Pseudacris regilla*) and Western Toad (*Bufo boreas*) are also present in the watersheds. Non-native brook trout (*S. fontinalis*), lake trout, (*S. namaycush*), rainbow trout (*O.mykiss*), and grayling, (*Thymallus arcticus*), are present within the project area. Warmwater species such as northern pike (*Esox lucius*), perch (*Perca flavescens*), and most recently walleye (*Sander vitreus*) can be found in some lower elevation lakes and river sloughs on the valley floor primarily off forest. These non-native fish are desired by anglers and provide recreational angling opportunities both on and off the forest, however no plan components are being specifically developed for these species since the plan components for bull trout and westslope cutthroat trout will provide stream habitat conditions for trout species. Riparian management zones will provide for protection of lakeshore habitat and water quality.

This analysis also considers Meltwater stonefly, *Lednia tumana*, which is a candidate species and has been found in glacier meltwater in Glacier National Park and in upper Tunnel Creek below Mount Grant and above Sunburst Lake on the forest.

Bull trout (threatened species)

In November 1999, the U.S. Fish and Wildlife Service (Service) listed all populations of bull trout within the coterminous United States as a threatened species pursuant to the Endangered Species Act of 1973, as amended (Act) (64 FR 58910; November 1, 1999). The 1999 listing applied to one distinct population segment (DPS) of bull trout within the coterminous United States. The Forest is in the Columbia Headwaters recovery unit. Recovery actions for bull trout (USFWS 2015), developed in cooperation with Federal, State, tribal, local, and other partners, fall generally into four categories:

1. Protect, restore, and maintain suitable habitat conditions for bull trout.
2. Minimize demographic threats to bull trout by restoring connectivity or populations where appropriate to promote diverse life history strategies and conserve genetic diversity.
3. Prevent and reduce negative effects of nonnative fishes and other nonnative taxa on bull trout.
4. Work with partners to conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks, and considering the effects of climate change.

Two basic life history forms of bull trout are known to occur: resident and migratory. Resident bull trout spend their entire lives in their natal streams, while migratory bull trout travel downstream as juveniles to rear in larger rivers (fluvial types) or lakes (adfluvial types). The populations in the Flathead are an adfluvial migratory group, with juveniles moving downstream to rivers or lakes at age 2-3, and then returning around age 6 to spawn. Bull trout spawning occurs in the fall, and the eggs incubate in the stream gravel until hatching in January (Fraley and Shepard 1989). The alevins remain in the gravel for several more months and emerge as fry in early spring. Unlike many anadromous salmonids, which spawn once and die, bull trout are capable of multi-year spawning

(Fraley and Shepard 1989). The historic range of bull trout stretched from California, where the species is now extinct, to the Yukon Territory of Canada (Hass and McPhail 1991).

Several factors have contributed to the decline of bull trout. Habitat degradation, interaction with exotic species, over harvesting, and fragmentation of habitat by dams and diversions, are all factors contributing to the decline (Rieman and McIntyre 1995). A change in the species composition of Flathead Lake is perhaps the most important factor in the decline of the upper Flathead bull trout subpopulation (McIntyre 1998). Between 1968 and 1975, opossum shrimp (*Mysis relicta*) were stocked in three lakes with tributaries feeding into Flathead Lake; the shrimp were then able to migrate downstream and they became established in Flathead Lake. The shrimp were documented in Flathead Lake in 1981, and populations peaked in 1986. Two non-native species, lake trout (*Salvelinus namaycush*) and lake whitefish (*Coregonus clupeaformis*), expanded as juvenile fish benefited from the addition of shrimp to the prey base.

It is believed that the expansion of the lake trout and lake whitefish contributed to the decline of bull trout (McIntyre 1998). The mechanisms of the decline are not well understood, however, it is assumed that the loss of kokanee as a food source for bull trout and competition/predation with Lake trout was a major contributor to the decline in bull trout. Bull trout populations remain healthy in Hungry Horse Reservoir. Lake trout are absent from Hungry Horse but have recently been documented in Swan Lake which has raised concern among land and fishery managers and efforts are underway to reduce lake trout (see below).

Westslope cutthroat trout (species of conservation concern)

The USFWS was petitioned by environmental groups to include the westslope cutthroat trout under the protection of the Endangered Species Act. In 2003, the USFWS determined that the listing was not warranted due to wide species distribution, available habitat on public lands, and conservation efforts underway by state and federal agencies. The South Fork Flathead River drainage is considered a stronghold for westslope cutthroat trout throughout its range (Shepard et al. 2005).

Westslope cutthroat trout have two possible life forms, resident and migratory. Migratory forms are further divided into adfluvial (migrates to lakes) or fluvial (migrates to rivers). All life forms spawn in tributary streams in the springtime when water temperature is about 10 Celsius and flows are high (Liknes and Graham 1988). Cutthroat trout spawn when they are about 4 or 5 years old, and only a few survive to spawn again (McIntyre and Rieman 1995). Fry emerge in late June to mid-July and spend one to four years in their natal streams. Resident fish spend their entire lives in tributary streams, while migratory forms may travel miles as they move between waterbodies and spawning habitat.

The primary reasons for this species' decline are similar to those discussed above for the bull trout. Habitat loss is considered a widespread problem. Cutthroat trout have declined across their range due to poor grazing practices, historic logging practices, mining, agriculture, residential development, and the lingering impact of forest roads. Locally on forest, logging and associated road building have had the greatest impact upon populations. Fish have been unable to use spawning habitat due to barriers created by dams and road culverts. Genetic introgression with rainbow trout threatens long-term persistence of westslope cutthroat trout, and is most likely the greatest threat (Hitt 2003). Climate change may likely exacerbate the rate of introgression (Muhlfeld 2104). Efforts in the South Fork have been underway since 2006 to chemically remove hybrids from high mountain lakes to protect and restore westslope cutthroat trout genetic integrity and will be completed in 2017 to protect this important stronghold (BPA 2005). Other efforts have included the construction of barriers in the Swan to prevent upstream invasion of brook trout and electrofishing removal in Sheppard Creek since 1998 to also remove brook trout.

Meltwater stonefly (Candidate species)

The Meltwater Lednian Stonefly is a small, dark colored species of extremely cold glacier-fed streams primarily at high elevations in Glacier Park. Little else is known about its habits or ecology, except that the adults have hatched by mid-summer (July-August) and are presumably mating during this time. The meltwater stonefly was found on forest in the headwaters of Tunnel Creek below Grant Glacier in 2010 and above Sunburst Lake in 2015. This species could possibly be found in other glacier meltwater areas although this habitat type is rare on forest.

The larvae are found in small alpine, mountain streams (Newell and Minshall 1976), but only those closely linked to glacial run-off (Treanor et. al 2013). Ecologically this species is a cold-water stenotherm that is unable to tolerate warm water temperatures (greater than 10 degrees celsius) and is generally collected within a few hundred meters of the base of glaciers or snow melt derived streams.

The greatest concern with this species is climate change which will continue to shrink glaciers that this species is dependent on for survival. Estimates are that glaciers will be gone from Glacier National Park by 2030, essentially the life of this plan. The Forest does not conduct activities in this species habitat and thus will have no effect on the meltwater stonefly.

Western Pearlshell Mussel (Sensitive species Alternative A only)

Western pearlshell is a state species of special concern in Montana (S2) and is a species previously identified as sensitive on the Region 1 Sensitive Species list (USDA Forest Service 2011b). Montana’s populations of M. falcata may be significantly contracting and becoming less viable with stream-decreased flows, warming, and degradation. Previously reported mussel beds in the larger rivers (Blackfoot, Big Hole, Bitterroot, Clark Fork,) are extirpated from the drainage or are at such low densities that long-term viability is unlikely. This mussel species appears to have crossed the continental divide in Montana from west to east with its salmonid host, the westslope cutthroat trout, *Oncorhynchus clarki lewisi*. This is the only native trout in the Missouri River headwaters. Reports of the eastern *M. margaritifera* in Montana are apparently due to the mistaken assumption that a mussel could not cross the continental divide (MNHP and MFWP 2011b).

Western pearlshell occurs in sand, gravel, and even among cobble and boulders in low to moderate gradient streams up to larger rivers. This species prefers stable gravel and pebble substrates in low-gradient trout streams and intermountain rivers. Western pearlshell is found in runs and riffles in stable main-current channel areas. This mussel is intolerant of silt and warm water temperatures (Stagliano et al. 2007).

In large river systems, *M. falcata* attains maximum density and age in river reaches where large boulders structurally stabilize cobbles and interstitial gravels. Boulders tend to prevent significant bed scour during major floods. Boulder-sheltered mussel beds, although rare, may be critical for population recruitment elsewhere within the river, especially after periodic flood scour of less protected mussel habitat. In localized areas, where canyon reaches are aggrading with sand and gravel, *M. falcata* is often replaced by *Gonidea angulata*.

Nearly all mussels require a host or hosts during the parasitic larval portion of their life cycle. Hosts are usually fish species, and hosts for *M. falcata* in Montana were typically and historically *Oncorhynchus* spp. (e.g., westslope cutthroat trout); but Salmo and *Salvelinus* (introduced species) and even *Rhinicthys* and *Catostomus* (dace and suckers) are anticipated to be suitable hosts as well.

Western Pearshell Mussels have been found in Ashley Creek about 2 miles below the forest boundary (Stagliano 2007). Stagliano (2011) modelled likely mussel habitat on the forest and the forest has surveyed many of the likeliest sites and have not found mussels on the forest. In addition, the site on Ashley Creek is about 7 miles below Ashley Lake. The forest's ownership is primarily above Ashley Lake and any sediment generated from forest activities would settle in the lake. Therefore, there will be no impact on western pearlshell mussels and they will not be discussed further.

Bull trout and westslope cutthroat status by subbasin (8th digit HUC)

South Fork Flathead River

The South Fork Flathead River originates at the confluence of Danaher and Youngs creeks in the Bob Marshall Wilderness area and flows north 57 miles into Hungry Horse Reservoir. It drains a 1,663 square mile area with an average annual discharge of 3,522 cubic feet per second (cfs). Bull trout are native to the South Fork Flathead River drainage and are distributed throughout the Flathead River Basin. Prior to human intervention, migratory bull trout that spawned and reared in the South Fork occupied Flathead Lake as adults. Anecdotal information indicates that large adult bull trout were seasonally common in the South Fork and several of its tributaries (MBTSG 1995). Construction of Hungry Horse Dam in 1952-53 blocked access to the entire South Fork drainage. About 38% of the spawning and rearing area once available to the Flathead bull trout population was cut off (Zubik and Fraley 1987). Water stored in Hungry Horse Reservoir is used for power production, irrigation, recreation, flood control, and to augment downstream flows for salmon passage on the Columbia River.

The construction of Hungry Horse Dam in 1952 isolated the South Fork population of bull trout from the rest of the Flathead River system. The MBTSG (1995) reported that the South Fork Flathead drainage upstream from Hungry Horse Dam is the "most intact native fish ecosystem remaining in western Montana." Currently, sub-adult bull trout upstream of the dam in Hungry Horse Reservoir or in the South Fork mainstem above the reservoir reside for several years prior to maturity and migration into tributaries to spawn. The majority of the spawning and rearing habitats for the South Fork bull trout population are located in the back country areas, most of which is in the Bob Marshall Wilderness. Juvenile bull trout rear from one to four years before moving downstream to the mainstem or to the reservoir. In 1993, the Montana Department of Fish, Wildlife, and Parks (MDFWP) surveyed tributaries suspected of bull trout spawning and found a total of 366 redds in the South Fork drainage (MBTSG 1995). Of these redds, 64 were in non-wilderness areas and 302 in wilderness areas. No spawning was observed in 21 of the 36 streams surveyed (Weaver 1993).

Eight of the streams that were surveyed in 1993 were selected as index streams for monitoring adult bull trout abundance. Based on 1993 and 1994 spawning site inventories, the total population of bull trout in Hungry Horse Reservoir was estimated at 2,932 and 3,194 respectively (Weaver 1993, 1994). The MBTSG (1995) reported that the South Fork bull trout population trend is stable based on available data. However, they cautioned that data are limited and more long-term information is needed for a full assessment. Monitoring red counts over the last 20 years supports the premise that the bull trout population is stable. Additionally, Weaver (1998) reported that sinking gill net sets in the fall in Hungry Horse Reservoir indicate that catches appear to be some of the highest on record during the 38-year period since gill netting began. This data also suggests a relatively stable population. This is significantly different than the rest of the Flathead River Basin subpopulations. The current status of Flathead River subpopulations of migratory bull trout in the Middle Fork and North Fork Flathead River are depressed and the trend is declining. Refer to figures 3 through 7 for bull trout redd counts on the Forest. Redd counts from 1993 to 2015 in the South Fork indicate that the bull trout population is stable (figure 6).

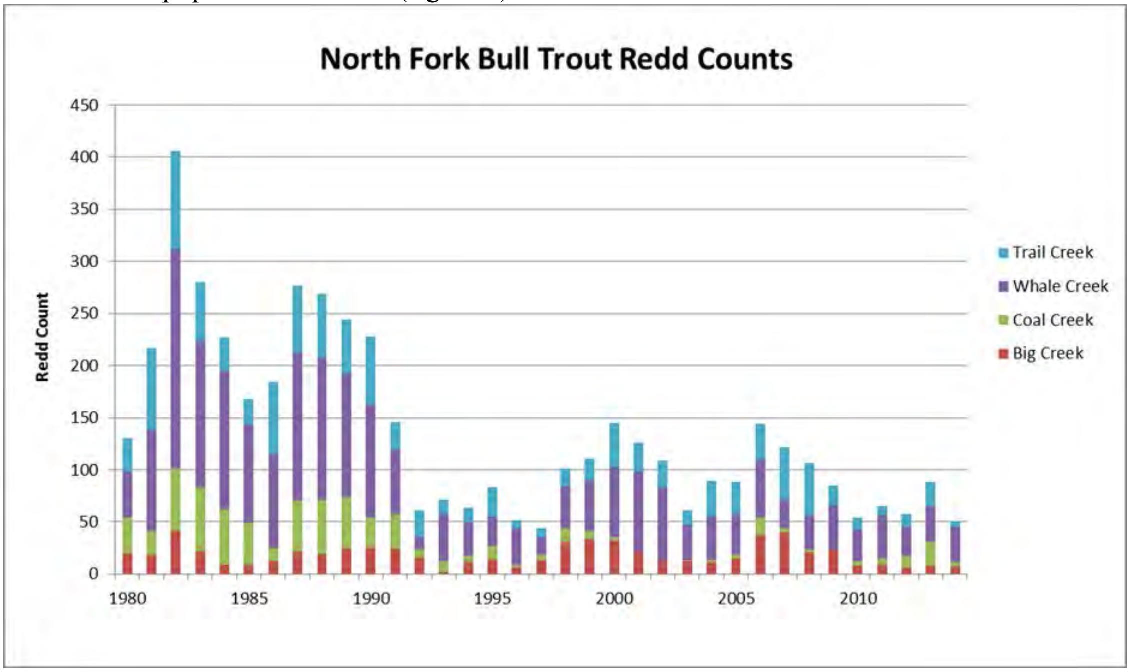


Figure 3. North Fork bull trout redd counts, 1980-2015.

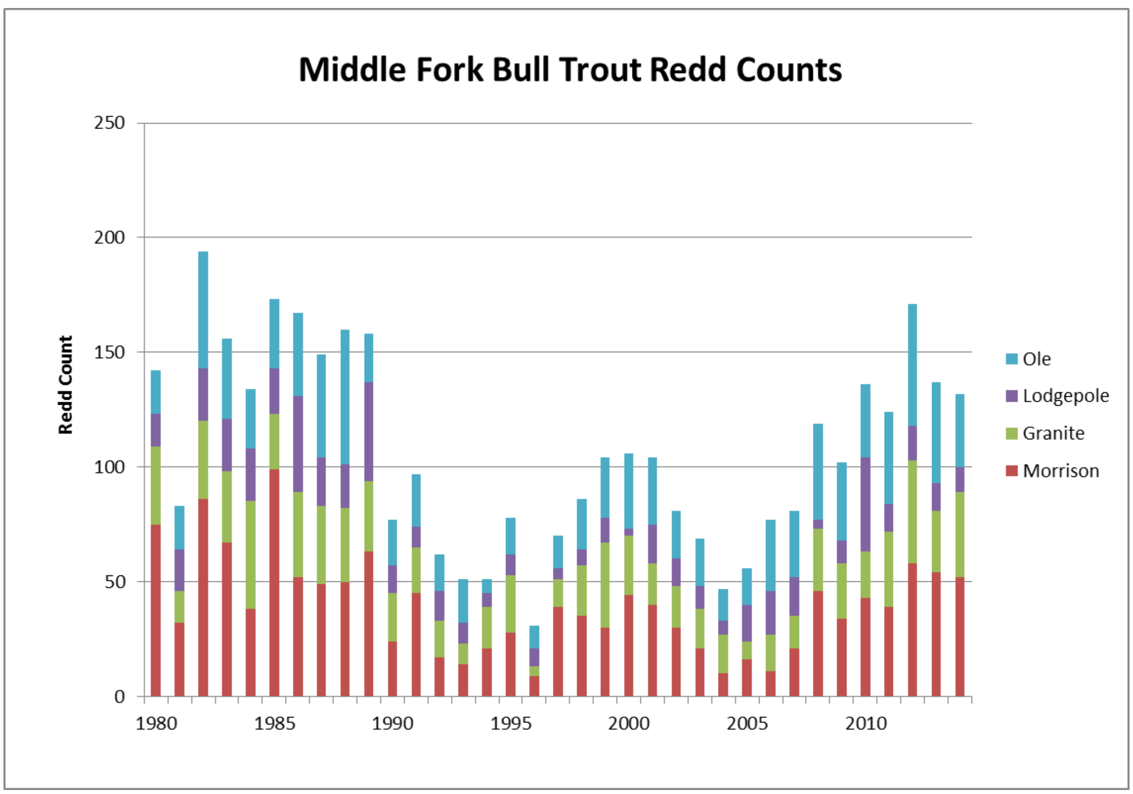


Figure 4. Middle Fork bull trout redd counts, 1980-2015.

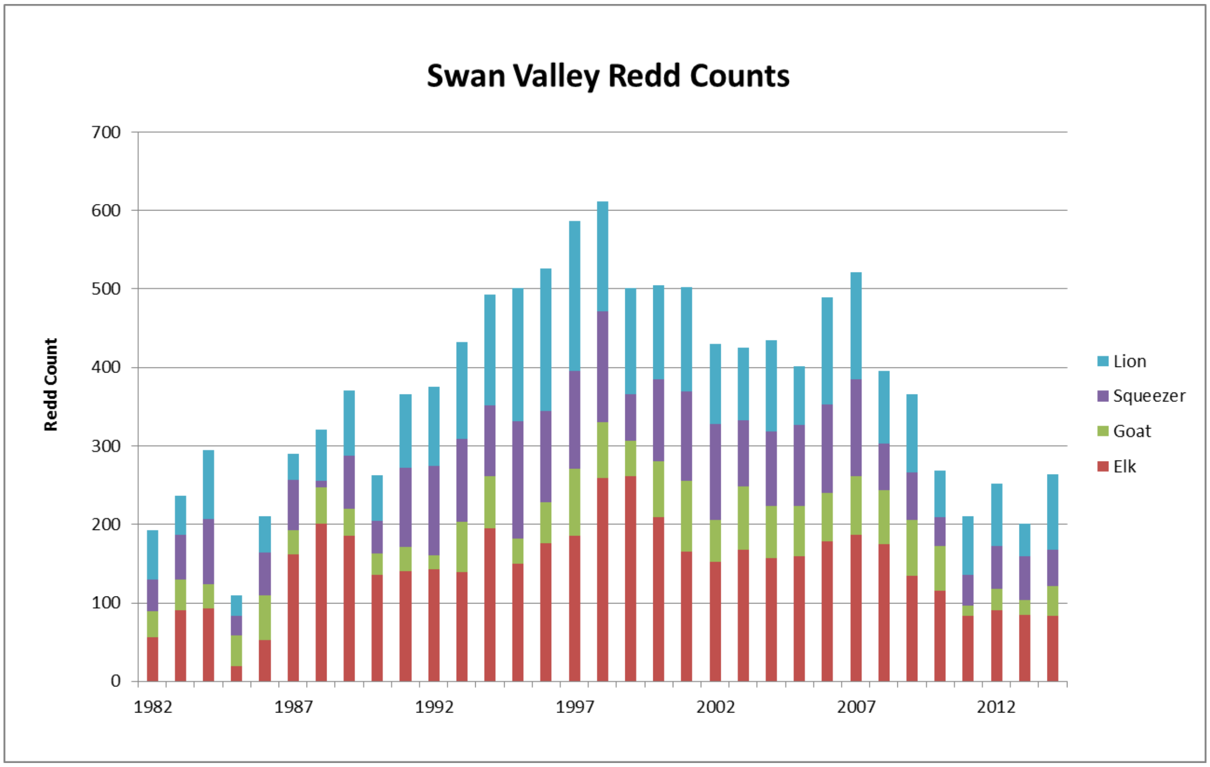


Figure 5. Swan Valley bull trout redd counts, 1982-2015.

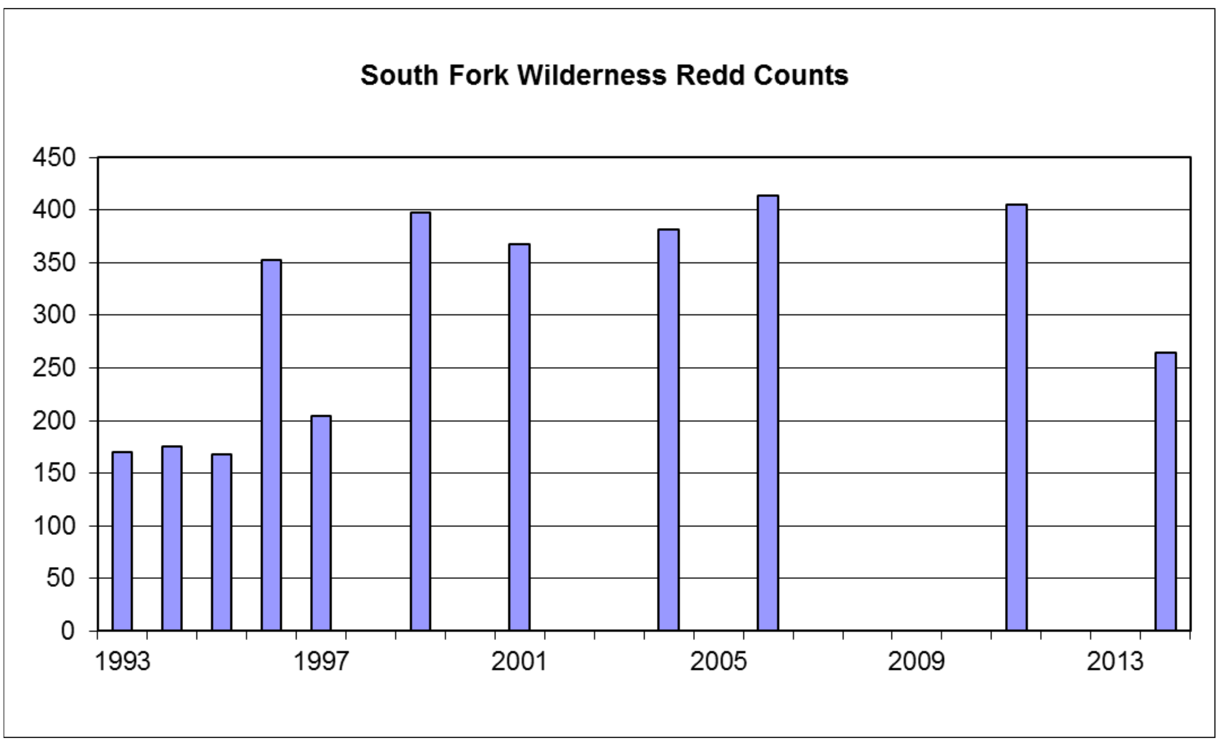


Figure 6. South Fork wilderness redd counts, 1993-2014.

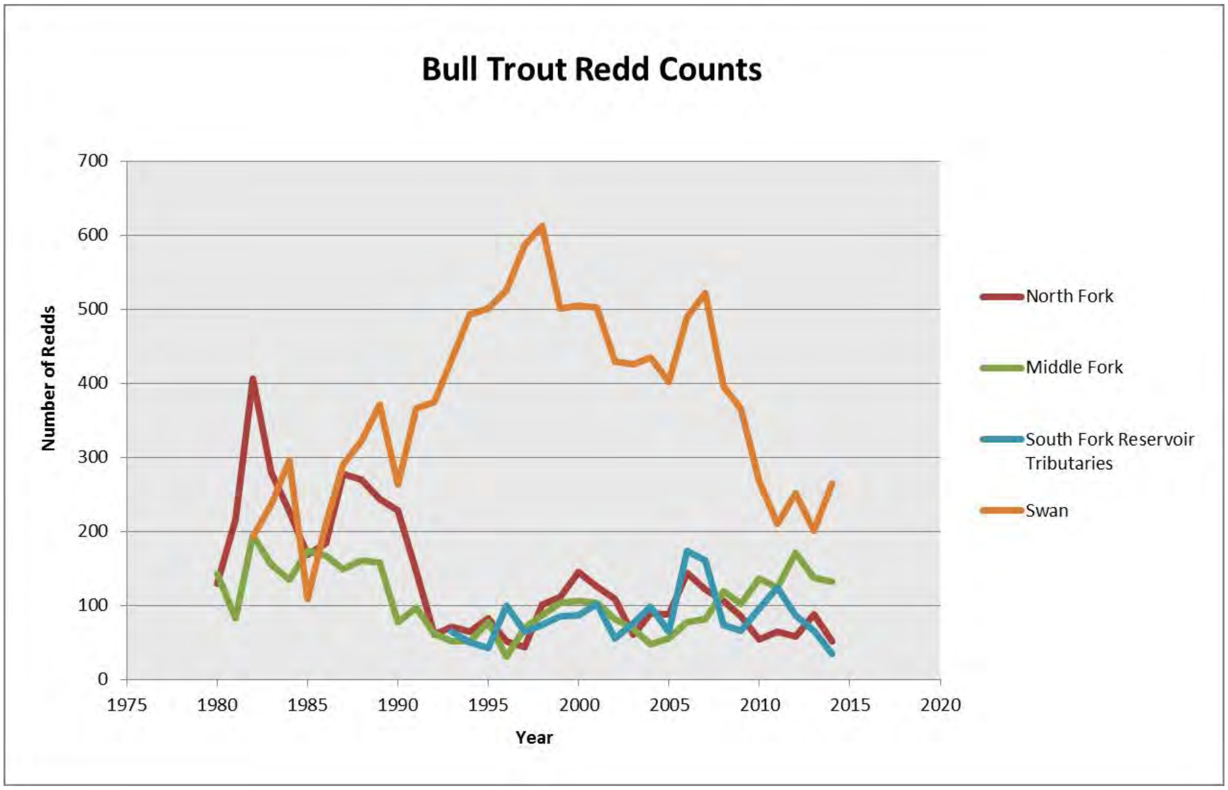


Figure 7. Bull trout redd counts all basins, 1980-2015.

Two known disjunct populations of bull trout occur in the South Fork Flathead River drainage. Big Salmon Lake supports a migratory bull trout population which uses 5.5 miles of Big Salmon Creek upstream from the lake to a barrier falls for spawning and rearing. Doctor Lake also supports a bull trout population, however little is known about this population, but it is suspected to spawn and rear in a short reach of Doctor Creek upstream of the lake (MBTSG 1995).

Core areas are drainages that currently contain the strongest remaining populations of bull trout and that must be given highest priority for protection as they will be the primary source of fish for recolonization (Rieman and McIntyre 1993). They are usually relatively undisturbed and have been identified as needing the highest level of protection (MBTSG 1995). Core areas in the South Fork include some of the tributaries flowing directly into Hungry Horse Reservoir. These include the entire drainages of Wounded Buck, Wheeler, and Sullivan creeks. Also included as core areas are tributaries to the river upstream of the reservoir (Spotted Bear River, Bunker Creek, Little Salmon Creek, White River, Gordon Creek, Youngs Creek, and Danaher Creek) and the South Fork itself above Gordon Creek.

Nodal Habitats are waters which provide migratory corridors, overwintering areas, or other areas that are otherwise essential to bull trout at some point in their life history (MBTSG 1995). Nodal habitat for the South Fork population is provided by the mainstem South Fork Flathead River downstream from Gordon Creek, including Hungry Horse Reservoir (MBTSG 1995).

The MBTSG (1995) reported that the main single threat to the long-term survival of bull trout inhabiting the South Fork Flathead River is illegal introductions, which may vary depending on species introduced. Other threats are tied largely to forestry practices in the non-wilderness portion of the watershed and the water level manipulations in Hungry Horse Reservoir. Illegal harvest during fall spawning in the back country areas (e.g. fall hunting in the Bob Marshall) was also identified as a problem in the drainage.

The South Fork Flathead River drainage, upstream of Hungry Horse Dam, is considered the most intact native fish ecosystem remaining in western Montana (MBTSG 1995). The 52 years of isolation of the South Fork Flathead River bull trout population and the wilderness habitat component has contributed to its relatively healthy population. There still remains uncertainty as to what factors will be needed to maintain a healthy population in the future however.

The MBTSG (1995) has suggested that an appropriate conservation goal is to maintain the status quo. It is believed that protecting and maintaining the existing native species complex through natural production; maintaining the current genetic structure and diversity; and ensuring operation of Hungry Horse Dam does not exceed the desired minimum pool level that the conservation goal to meet bull trout life history requirements in the South Fork Flathead River will be met.

Westslope cutthroat populations in the South Fork are arguably the strongest within their range (Shepard et al. 2005), given that there are no non-native fish, except for grayling in Handkerchief Lake and the area is primarily wilderness.

Middle and North Fork Flathead River

The Flathead River drainage supports one of the largest migratory bull trout populations in the United States. This population spawns in the tributaries of the North Fork and the Middle Fork of the Flathead River. Historically, prior to the construction Hungry Horse Dam and Reservoir, Flathead Lake bull trout had access to all three forks of the Flathead River (North, South, and Middle Forks) and bull trout were widely distributed throughout the drainage. The South Fork population is disconnected from the Flathead Lake population of bull trout and has been since the construction of Hungry Horse Dam over 60 years ago. The Middle and North populations are considered one meta-population since these fish depend on Flathead Lake for a major part of their life cycle. Juvenile fish rear in the tributaries of the Middle and North Fork for one to three years before migrating back to Flathead Lake (Fraley and Sheppard 1989).

The Middle Fork of the Flathead River originates in the Great Bear Wilderness at the confluence of Bowl and Strawberry Creeks. It flows for 47 miles to Bear Creek along U.S. Highway 2 where it forms the southern boundary of Glacier National Park. It then flows for 54 miles to its confluence with the North Fork. There are 19 streams in the Middle Fork subbasin which are known to support bull trout, including five in Glacier National Park.

At present, the predominant life history form of bull trout in the Middle Fork system is the lacustrine-adfluvial. No resident populations are known to exist and there are no indications that fluvial populations are present. Adfluvial fish reach sexual maturity in Flathead Lake at about age 6 and migrate upriver beginning in April. They reach the North and Middle Forks in June and July and enter tributaries in August with spawning commencing in late September and October when water temperatures drop to 9-10 degrees C (Fraley and Sheppard 1989). Incubation of eggs to emergence of swim up fry lasts about 200 days with emergence occurring in April. Juvenile bull trout rear for 2 to 3 years in the streams until they migrate downstream to Flathead Lake.

Unlike the South Fork bull trout population, recent monitoring data indicate declining numbers of spawning bull trout in the Middle Fork and North Fork River systems. This has caused concern about the status of these Flathead Lake migratory bull trout. Bull trout numbers are down significantly in the Middle Fork and North Fork. The mechanisms for the decline in the Flathead Lake migratory population are not completely understood. However, the decline coincided with the introduction and subsequent population increase in mysis shrimp in Flathead Lake, which in turn, has been related to the recent change in the composition of the fish community in Flathead Lake. Lake trout and lake whitefish now dominate the fish community and may be responsible for the decline in bull trout as well as other species. These changes in the Flathead Lake and River system are considered the primary threat to bull trout in the entire drainage system (USFWS 2015). Lake trout and bull trout competition has been documented elsewhere. Donald and Alger (1992) looked at 34 lakes in the distributional overlap of the species and found that in 28 cases, only one species was present. In the lakes where they were sympatric, lake trout were the dominant species and three case histories were documented where lake trout completely displaced bull trout. A secondary threat is the high incidental catch of bull trout and the strong fisheries management emphasis on introduced species as well by-catch from gillnetting of lake trout (MBTSG 1995b, USFWS 2015). Forestry issues are also considered important in the managed portions of the Middle and North sub-basins.

A panel of fishery experts concluded that if bull trout are to return to the levels of the 1980's, then lake trout have to be reduced by 70 to 90% from current levels (McIntyre 1998). Ten of the 12 panel members gave a 60 to 80% probability that lake trout can be reduced to achieve bull trout recovery goals. The panel further concluded that introduced species are causing a decline of bull trout and cutthroat trout in Flathead Lake. This conclusion is bolstered by the fact that bull trout populations remain healthy in Hungry Horse Reservoir where lake trout are absent. It should also be noted that outside of the isolated South Fork subbasin, bull trout in the Flathead system have declined equally in wilderness and managed streams. These declining trends in both managed and wilderness streams may indicate that habitat degradation may not be a primary factor in bull trout population declines in the Middle and North Fork Subbasins.

Bull trout numbers in Flathead Lake have been estimated based upon redd counts. In 1982, the highest bull trout redd count year, about 13,000 adult bull trout were estimated in Flathead Lake (Weaver 1998). The lowest redd count year was 1996 and adult bull trout were estimated at 916 fish (Weaver 1998). It is important to note that these are gross estimates based on complex assumptions, but these numbers do provide an indication of how much has been lost.

Core areas are drainages that currently contain the strongest remaining populations of bull trout and that must be given highest priority for protection as they will be the primary source of fish for recolonization (Rieman and Mclntyre 1993). They are usually relatively undisturbed and have been identified as needing the highest level of protection (MBTSG 1995b). Core areas in the Middle Fork include: Nyack, Park, Ole, Bear, Long, Granite, Morrison, Schafer, Clack, Strawberry, and Bowl Creek drainages. Nyack, Park, Ole creeks are within Glacier National Park. Core areas in the North Fork include: Trail, Whale, Red Meadow, Coal and Big Creek drainages. These core areas are identical to bull trout critical habitat. Climate change models (Isaak et al. 2015) may be a useful tool to determine where cold water might persist into the future, thus identifying important watersheds to protect as part of a Conservation Watershed Network.

The restoration goal for the migratory population of bull trout in the Flathead River drainage is to maintain or restore self-sustaining populations in the core areas, protect the integrity of the population genetic structure, and enhance the migratory component of the population (MBTSG 1995b). The specific goal is increase bull trout spawners to the level recorded in the 1980's and to maintain this level for 3 generations. The average 1980 redd count in the Middle Fork index streams was 151 (MBTSG 1995b). In 2015, 182 redds were counted in the index streams.

Flathead bull trout spawning site inventories from 1980 – 2015 in index stream sections are monitored annually. Identical sections of these eight index streams are counted annually and represent a known portion (about 45 percent) of the total bull trout spawning in the drainage. This indicates that index counts capture basin-wide trends, although there is some shifting between individual streams.

Westslope cutthroat trout that are migratory have also been affected by lake trout predation in Flathead Lake while resident populations remain strong.

Swan Subpopulation

Up until the last decade, the Swan River drainage provides habitat for one of the strongest collections of local migratory bull trout populations remaining in the State of Montana (MBTSG 1996b). At least 23 tributaries support some level of juvenile bull trout rearing (Leathe and Enk 1985). Bull trout spawning occurs in at least 10 tributary drainages. Core areas include: Elk Creek, Cold Creek, Jim Creek, Piper Creek, Lion Creek, Goat Creek, Woodward Creek, Soup Creek, and Lost Creek as well as Swan Lake, Holland Lake and Lindbergh Lake. Major spawning and rearing areas in the Swan River drainage are highly groundwater influenced which reduces the risk of impact from drought conditions. Bull trout are thought to be primarily adfluvial fish and mature in Swan Lake, located at the northern end of the Swan Valley. The recent invasion of lake trout into Swan Lake threaten the long-term viability of this population. Efforts are underway for removing lake trout from Swan Lake and are discussed below.

The Swan Valley has historically been one of Montana's strongest bull trout populations. However, in 1998, anglers began to occasionally catch adult sized (20-30 inch) lake trout from Swan Lake and the Swan River. In 2003, the level of concern was compounded when biologists gillnetted juvenile lake trout from Swan Lake, indicating that wild reproduction was occurring. Since 2003, lake trout catch by anglers as well as during Montana Fish, Wildlife & Parks (FWP) biological sampling continued to increase, another indication that the population was expanding. Research efforts from 2006-2008 focused on lake trout population demographics and exploring potential techniques to reduce lake trout numbers while minimizing bull trout bycatch. Based on case histories from nearby waters, managers determined that developing long-term management actions to control this increasing lake trout population was necessary in order to maintain the popular bull trout and kokanee fisheries.

In 2009, FWP released an environmental assessment (EA) for a three-year experimental removal of lake trout in Swan Lake. From 2009-2011, over 20,000 lake trout were removed from Swan Lake. Modeled total annual mortality rates for lake trout year classes vulnerable to the nets (Age classes 3, 4, and 5) were higher than literature suggests are sustainable (50%). FWP released another EA in May 2012 for a five-year extension of the project to further evaluate the long-term effectiveness of the current lake trout suppression effort relative to measurable goals and specific success criteria outlined in the original 2009 EA. About 25,000 lake trout have been removed under the suppression program from 2012-2014 (Rosenthal et al. 2015). The forest has been supportive of the netting effort, both financially and socially.

Bull trout redd counts (i.e., spawning beds) in the Swan drainage in 2014 were higher than in 2013 and juvenile abundance surveys conducted in select streams indicated that the juvenile numbers remain at least stable.

Westslope cutthroat trout populations remain strong in some tributary streams but have been replaced by brook trout and have hybridized with rainbow trout in other streams.

Non-native fish

The Draft Columbia Headwaters Recovery Unit Implementation Plan for Bull Trout Recovery Plan (USFWS 2015) documents primary threats to bull trout. The greatest threats throughout the Flathead are non-native species interactions, primarily lake trout. It is important to note that habitat condition is not listed as a primary threat in any of the Flathead Core areas except for Upper Whitefish Lake which is primarily within the Stillwater State Forest managed by Montana DNRC. PIBO monitoring data for bull trout watersheds indicates that habitat is in good condition. Declines in bull trout populations are largely associated with non-native species interactions.

The primary threats as identified in the RUIP in the Swan and Flathead Lake core areas are:

"Nonnative fishes: Lake trout represent the single largest primary threat to bull trout, overwhelming the FMO habitat in Swan Lake. Lake trout invasion and expansion in the past 20 years, coupled with a robust Mysis population from a 1970's introduction, has compromised bull trout survival (predation) and introduced competition for a limited prey base (primarily kokanee) available to piscivores. Brook trout have been present in most SR tributaries for a half century or longer, with no documented recent change in status, but in some important SR tributaries (e.g., Lion, Goat) resulting in high documented rates of hybridization. Hybrids are abundant throughout SR and FMO (observed hybrids to 8-10 lbs in Swan Lake), further reducing potential bull trout recruitment. (FMO = foraging, migrating, and overwintering habitat, SR = spawning and rearing habitat)""In the 1980's, the nonnative lake trout expanded in the Flathead Lake and mainstem Flathead River FMO habitat, triggered by the accidental Mysis introduction (now estimated 1+ million lake trout population). Concurrently, the complete collapse of the formerly abundant kokanee forage base for lake trout likely lead to substantial increase in predation of bull trout and competition for other foods. This combination of effects likely caused the subsequent rapid decline in bull trout, demonstrated by a 75 percent decline in redd counts from the 1980s levels. Partial recovery of bull trout occurred in the 2000's (to approx. one-half 1980's levels) but gains have stagnated and are fluctuating below conservation objectives. Nonnative lake trout predation and competition remains a substantial threat to bull trout in this system. Predation from nonnative northern pike populations in the mainstem Flathead River is a documented threat."

"Fisheries Management: Loss of bull trout from angling bycatch mortality (combined Flathead Lake and River system) and occasional poaching contributes to the low populations in this system. Low population size (single digit redd counts) are a concern in some SR tributaries, especially in recent years in the North Fork Flathead SR streams. Sampling mortality of bull trout due to aggressive monitoring in SR habitat (e.g., North Fork Flathead) and gillnetting for lake trout suppression in Flathead Lake may directly impact potential recruitment and reduce local populations."

Flathead Lake bull trout have similarly declined due to negative interactions with lake trout. The Confederated Salish and Kootenai tribes began a netting program in 2014 to reduce lake trout with a long term goal to reduce the population of age 8 and older lake trout by 75%. Modelling results show that suppressing lake trout can result in an increase in bull trout (Hansen 2015). In 2014, about 8000 lake trout were netted and another 68,000 were harvested through general angling and the Mack Days tournament (Hansen 2015).

Hybridization of westslope cutthroat trout with non-native rainbow trout is increasing in the Flathead River drainage (Muhlfeld et al. 2015; Boyer et al. 2008). Hybridization reduces reproductive success of westslope cutthroat trout and can lead to a loss of the species and genetic material (Muhlfeld et al. 2009a). Several efforts are ongoing to reduce hybridization. Trapping of rainbow trout in select

Flathead tributary streams, i.e., Abbott Creek and Rabe Creek on forest is designed to prevent the spread of hybridization up river into the North and Middle Forks. Removal of hybrids from high mountain lakes within the South Fork since 2006 is nearing completion which will secure a large stronghold for the species without threats from non-native brook trout and rainbow trout (MWFP 2006). Kovach et al. (2014) demonstrated that dispersal of hybrid individuals from downstream source populations is a significant factor, and probably the primary mechanism contributing to the spread of hybridization between cutthroat and rainbow trout. Temperature may play a key role in reducing hybridization between the two species with westslope cutthroats favoring colder water, thus climate change is a concern in the long term. The distribution and colonizing success of rainbow trout is positively correlated with temperature in areas where westslope cutthroat trout are native (Muhlfeld et al. 2009a, Muhlfeld et al. 2009b). Brook trout tolerate increased sediment levels (Shepard et al. 1998, Shepard 2004) better than cutthroat trout. Thus, the negative effects of nonnative fish on native species can be expected to amplify with increases in other system stressors.

Aquatic invasive species

Nonnative invasive species are a serious threat to all aquatic habitats in the United States. The severity of this threat is difficult to assess or predict in this plan area, or in any other specific locality. Zebra and quagga mussels are a serious threat to water quality and aquatic lifeforms. Fortunately, these mussels have not been found in the Flathead Valley, however Eurasian milfoil has been documented just off forest in Beaver Lake outside Whitefish. Mandatory check stations for all watercraft have become throughout Montana to prevent the spread of invasive species.

When a new aquatic invasive species invasion occurs in a locality, it often requires research and observation time before reliable inferences can be made regarding spread patterns, specific effects, and potential containment strategies. A baseline often is lacking to predict how an invasive species from another region or continent will respond when introduced into a new environment. Since a local environment contains a unique assemblage of thousands of interconnected components and processes, the results in one area can vary slightly or significantly from previously infected areas.

If an aquatic invasive species becomes established, elimination may be nearly impossible and efforts for containment can be very difficult, time consuming, and expensive. Thus, prevention of invasions is of paramount importance in land and natural resource management. This involves recognizing the vectors for infection and spread and implementing safeguards, or resource protection measures, to minimize and prevent the transmission of invasive organisms through these pathways. An example of a transmission vector would be pumps and other fire equipment that come into contact with water. This equipment is increasingly used and transported globally between projects. Microbes, spores, planktonic larval and adult stages, and plant materials can easily be spread on this and other equipment. Requiring effective sanitation and inspection measures would be appropriate resource protection measures.

3.2.6 Soil environmental consequences

Analysis focuses on activities that could have measurable impacts to soils over the next planning cycle, examining direct, indirect and cumulative effects on the “footprint” of federal land managed by the Flathead National Forest. Management activities that harvest timber, reduce fuels and decommission roads would have the highest potential for affecting soil condition. Effects of herbicide activities would be small and relegated to primarily administrative areas such as roadside spraying; adverse impacts to soils are controlled through limits on herbicide type and application rates (USDA 2001). To address cumulative effects, analysis discusses past and foreseeable future impacts on soil within the Flathead NF. Activities on adjacent private, state and federal ownership were not found to have detectible impacts to soil condition and therefore not discussed in this section.

The direction for forest service management of soil directly tiers to the National Forest Management Act (16 USC 1604) which stipulates to “ensure…evaluation of the effects of each management system to the end that it will not produce substantial and permanent impairment of the productivity of the land.” The past forest plan standards along with current guidance at the Regional and Washington office level interpret NFMA’s direction to manage for sustained soil productivity. The proposed forest plan would continue to manage for long term soil and site productivity (DC 1) on lands designated for growing vegetation. Areas dedicated to infrastructure such as administration sites, mines, system roads and campgrounds are not part of the productive landbase.

The new planning rule (USDA 2012) broadened the soil management direction, requiring plans to maintain or restore terrestrial ecosystems, put more succinctly in terms of ecosystem services. The forest service manual outlines these services as soil biology, soil hydrology, nutrient cycling, carbon storage and soil stability and support (USDA 2010).

Since attributes of ecosystem services are difficult to measure in the field, associated factors that can be readily observed and measured are used. These are: disturbance to surface organic matter, termed “dynamic” soil quality; and disturbance to topsoil termed “inherent” soil quality (Craigg et al. 2015). The core idea is that maintenance of soil quality provides for ecological services. Most management activities affect dynamic soil quality but it can improve relatively quickly as surface leaf litter and roots in the soil rebuild organic matter stocks. In contrast, inherent soil quality describes the summation of a site’s potential to support growth based on bedrock, climate, and rate of soil development. When management activities displace or remove portions of the topsoil, this impacts the inherent soil quality, which involves a longer term recovery than disturbance to dynamic soil quality. Using soil quality terminology, the Flathead NF desires management actions not lead to permanent impairment on land designated productive landbase (DC-Soil-1). This desired condition maintains or improves dynamic soil quality (DC-Soil-2) and conserves inherent soil quality. An instance in the latter case is acknowledging that management in steep topography has risks for slope failure. The Flathead NF therefore intends to manage activities to avoid triggering any landslides or slope failures (DC-Soil-3).

Stressors

Wildfire, prescribed fire, timber harvest and fuels management will continue to affect soil condition over the next planning period. The steep topography of the Flathead NF naturally predisposes slopes bared after wildfire to erode and deposit soil materials. Wildfire followed by intense rainfall will continue as a natural geomorphology agent as it has occurred episodically in Rocky Mountain forests for millennium (Miller et al. 2003, Kirschner 2001). When taking a closer look over a century scale, fire incidence coincides with warm phases of the Pacific Decadal Oscillation (Morgan et al. 2008). This latest warm cycle has continued with periods of dry springs with hot summers. These conditions align with large scale fire pattern based on tree-ring research (Ibid). Climate change predictions suggest a continued increase in monthly temperatures along with longer periods of summer drought that increase wildfire hazard (section Fire and Fuels Management). It’s uncertain if climate change trends may prevent the cyclic return to cooler conditions (Halofsky et al. 2015).

Fire impacts soils by burning up soil organic matter and producing surface conditions prone to soil erosion and deposition. The impact is described qualitatively as soil burn severity which conveys the magnitude of energy released from the consumption of fuels and the duration of heating. When fires burn all the above ground biomass and forest floor, a large portion of the nutrient supply is volatized into the atmosphere, while the residual products of burning creates higher mineral nutrient contents in soil layers (Neary et al. 1999, Erickson and White 2008). The soil inherent quality may remain intact after wildfire since wind driven fire rarely heats deep into soil (Hartford and Frandsen 1992). However, after the wildfire, the lack of forest canopy and bare soil creates conditions for high erosion hazard. Water and wind erosion transport and deposit soil material incrementally downslope until slopes stabilize. Erosion is highest where fires burn severely on steep hillsides; typical fires result in 10 – 30 percent of the fire area burning with high severity based on Burned Area Emergency Rehabilitation maps for the Flathead NF. Though natural, recovery in these areas depends on available moisture and recolonization from neighboring vegetation and soil patches. Dry southern slopes may recolonize slower from droughty conditions and thin soils.

Timber and fuels projects would continue as management activities that have the highest areal impact on soil condition over the next planning period, albeit at reduced levels than historical. Timber harvest treatment averaged about 11,000 acres per year at the inception of the forest plan in the late 1980’s, whereas now timber harvest averages around 2,000 acres per year. Amount of regeneration harvest cutting has trended downward, and intermediate harvest (thinning) and salvage harvest has trended upward. There has also been increased emphasis on timber harvest in the wildland urban interface.

The majority of harvest would occur on lands designated as suitable for timber production in the plan (see Timber section of the EIS). The exact location of future timber harvest will depend largely on factors of road access and site specific forest conditions relative to the desired conditions as outlined in the forest plan. However, uncertain disturbance events will also influence location and extent of harvest. For example, harvest peaks in the 1970s and 1980s largely responded to outbreaks of mountain pine beetle in lodgepole pine stands. Harvest in the 2000s followed large wildfire events, with salvage harvest accounting for about 25% of the harvest acres in that decade. Timber harvest may also include some areas regenerated in the 1970s that reach commercial size. However, young forests within recent wildfire areas will not reach commercial size during the life of the plan.

Road access will largely dictate timber harvest since the Flathead NF continues to reduce the road network to a manageable level. Costs of road maintenance and managing for habitat factor into the Forest’s decision to decrease the road template. At the time of the first forest plan, the Flathead NF was still actively building roads and extending its operational footprint. The network in the early 1990’s was 3,842 miles whereas now system roads account for 3,566 miles as of 2014. The difference is actually much more striking since road decommissioning has taken off the template 787 miles of classified roads from 1995 through 2015. Road management shifted to decommissioning roads in the late 1990’s with attention to maintaining grizzly core area and the corresponding need to reduce watershed effects. The new planning period should see continued emphasis on road decommissioning and any new system road building will likely be confined to re-alignments.

Effects from timber harvest

Harvesting timber requires machinery to cut and yard trees to landings sites that can compact and displace soils (Page-Dumroese et al. 2010, Cambi et al. 2015). Intensity and extent of impacts are managed by project mitigation and best management practices. Using soil monitoring, the forest service evaluates the efficacy of forest treatments by comparing disturbance extent against soil quality thresholds. When soil disturbance surpasses these thresholds then long term impairment could occur and the disturbance is considered detrimental to soil quality (USDA 2014). The Flathead NF forest monitoring has found that harvest methods that result in the highest disturbance use ground based harvest and skidding (Basko 2007, Milner 2015). Contemporary methods have reduced impacts with lower pressure, wider track or tread equipment, although economics and advances in mechanization have driven operators to favor ground based equipment. Over the last five years, the Flathead NF used ground based equipment methods to harvest 98 percent of the treated acres.

Within an activity area, typically defined as a treatment unit, timber harvest over the next planning cycle will likely impact soils at the same disturbance intensity as over the last fifteen years. Flathead NF soil monitoring over this period found logging systems result in detrimental soil disturbance, on a percent area basis, of 10-15 percent for ground based, 2-8 percent for skyline, and less than 2 percent for helicopter yarding (Milner 2015). The most pernicious impacts from ground based harvest remain at roughly three to five percent, mainly along high traffic skid trails and excavated skid trails (Milner 2015, Grier 2015). In contrast, historical timber harvest and site preparation practices left up to 30 percent of the soil area severely impacted (Klock et al. 1975, Clayton 1990), at least twice the disturbance area of contemporary harvest practices. Monitoring in the 1990's shows that dozer piling systems were replaced with feller bunchers and low severity broadcast burning for site preparation (Basko 2002).

A recent shift in timber practices that may increase soil disturbance over the next planning period is the use of a mixed ground based and skyline system on ground with greater than 40 percent slope pitch. Feller bunchers can range up to 50 percent slope pitches and have lower unit cost compared to hand felling. In these steep areas, feller bunchers harvest the trees and skyline systems yard the material to landings. Traditional ground based yarding does lead to the highest soil disturbance from repeat travel and heavy loads, but is excluded for these reasons from slopes greater than 40 percent. Monitoring has shown these mixed groundbase/ skyline systems to produce higher levels of soil disturbance than standard hand felling with skyline yarding, but can remain below the 15 percent areal standard. The use of mixed harvest systems will depend on site characteristics and operator performance. Soil-STD-Soil 1 and STD-Soil 2 are a relatively conservative approach to ensure that forest practices minimize damages to inherent soil quality.

Current findings from the FS Long Term Soil productivity study suggest that the extent of the impacts can relate to soil texture and organic matter (Powers et al. 2005, Page-Dumroese et al. 2010) but often as confounding variables. For example coarse textured soils appear resistant to compaction (Gomez et al. 2002), but also nutrient poor and so particularly at risk to the nominally least risky treatments that remove forest floor (Page-Dumroese and Jurgensen 2006, Page-Dumroese et al. 2010). Forestry research has underscored the importance of organic matter documenting the soil benefits of downed wood (Harvey et al. 1989, Graham et al. 1994), forest floor and soil organic matter (Jurgensen et al. 1997). However at this time we have no clear guidance on target levels by habitat or soil type since organic matter levels vary in step with forest succession. The Rocky Mountain Research Station, has responded by initiating studies to establish minimal necessary amounts of organic matter by habitat type. In the interim, the soil management on the Flathead has adopted the guideline FW-GDL-Soil 4 that conserves the forest floor and coarse wood levels. The forest floor can act as a mulch and buffers the soil microclimate to hold water on droughty sites for soil and plant processing in addition to providing a nutrient cache. Cold sites will not have the same water issues and thus adequate forest floor can be less constraining for growth. Across all sites, a minimal coverage of 85 percent areal extent stabilizes soils by providing protective ground cover that resists rainfall runoff (FW-GDL-Soils 3).

Coarse wood debris in the form of slash can provide a practical and effective mitigation for reducing harvest impacts on soil physical function and processes (Harvey et al. 1989, Graham et al. 1995). Leaving harvest slash along skid trails can prevent compaction (Han et al. 2009) and enhance soil recovery (Page-Dumroese et al. 2010). It's acknowledged that the coarse wood debris contains very little nutrient value (Liaho and Prescott 1999), but the benefits as groundcover and tempering soil climate promotes soil biologic activity. Target coarse wood levels balance needs for fuels reduction, soil production and wildlife. Optimal ranges for Montana and Idaho forests were reported as 5 to 20 tons per acre for warm sites and 10 to 30 tons per acre for cooler sites (Brown et al. 2003). The new plan leaves flexibility for coarse wood levels to vary at the project level depending on the fire risk, site type, and soil condition, but guidelines range between 10 to 40 tons per acre (FW-GDL-TE&V-10).

Level of timber harvest by alternative

The action alternatives vary by annual harvest level as shown in the Timber Environmental Consequences Section. The annual amounts of timber harvest estimated to occur the first decade would be 2,845 acres for Alternative B, 2,577 acres for Alternative C, and 1,833 acres for Alternative D. These estimates were modeled and best used for comparison rather than absolute values. For context, all action alternatives would likely treat less acres annually than the current annual average of 3,800 acres per year. All alternatives were equally limited by budget. Alternative D has a low amount of acres mainly due to the higher level of regeneration harvest and selection (by the model) of forest conditions more cost effective to treat. Alternative C shows nearly the same acres of harvest in the first decade as Alternative B, but nearly all acres would have intermediate treatments (modeled as commercial thinning). Refer to the Timber section for more information.

Alternative C's use of less regeneration harvest theoretically reduces the intensity of soil disturbance from less equipment travel and landing needs. Basko (2007) accounted for this potential reduction in soil disturbance predictions for the Flathead NF. However, forest monitoring has not found forest treatment intensity to equate to disturbance, because skid trails are a far greater disturbance factor than the degree of tree removal. Soil compaction largely occurs after only three passes by equipment and most pronounced on skid trails (Williamson and Neilson 2000, Han et al. 2009). Because the same skid trail networks are used for both thinning and regeneration type harvests they have near equal rates of soil disturbance (Milner 2015).

Forest reduction in system roads has increased reliance on temporary roads to access timber. Most temporary roads are historical routes that have existing prisms. Direction for temporary roads continues to evolve, although once the forest removes the roads from administrative infrastructure then these areas become part of the productive landbase. With the new forest plan, the forest will consider both stabilizing and improving soil recovery on these temporary road templates. Soil function shall be restored on temporary roads when management completes activities that use these roads. Restoration treatments shall be based on site characteristics and methods that have demonstrated to measurably improve soil productivity (FW-STD-Soil 3). The standard applies to both newly constructed and re-used templates.

The beneficial effects from road decommissioning will depend largely on site potential for recovery (Switaski et al. 2004). For example, droughty slopes with high evaporative loss on sunny aspects will recover more slowly than moist northern aspect slopes. Road treatments will stabilize the surface from erosion, while soil biology, soil chemical and hydrologic properties slowly recover as plants recolonize. Lloyd et al. (2013) quantified road recovery on the Nez Perce –Clearwater NF, showing faster soil recovery for treated roads where the road prism was outsloped along with some level of revegetation versus abandoned roads. She found topsoil developed on treated roads three times the depth over one decade than topsoil on roads abandoned for thirty years.

Standard mitigation techniques to limit soil damage from ground based equipment would be carried forward into this next planning cycle. Standard practices limit equipment operation on steep slopes (FW-GDL-SOIL1) and control seasonal operation when soils are more vulnerable to compaction and displacement. The plan however does not stipulate operation restrictions to particular conditions. Such limitations would be evaluated on a project basis due to variable soil properties.

The forest plan further addresses potential soil damage by avoiding sensitive soils prone to soil saturation and thin rocky soils that may be unstable. These areas were considered not suitable for timber production since harvest operations could produce irreversible soil damage and reforestation is uncertain. The areas were selected using mapping from the Flathead NF land system inventory (Martinson and Basko 1983) and the R1 Potential Vegetation Type Layer (USDA 2004) (see table 7). All action alternatives exclude these sensitive soil areas. In addition, the forest plan lowers risk of soil damage outside of these unsuitable areas with guidance that ground-disturbing management activities should not occur on landslide prone areas (FW-GDL-SOIL-02).

Table 7. Landtypes with sensitive soils excluded from the suitable timber base.

Landtype	Name	Sensitive Attribute
10-2, 10-3, 14-3	Wet alluvial deposits that include flood plains and moraine depressions with lake bed sediments	Poorly drained, saturated conditions
12	Moraine depressions with lake bed sediments where wet meadow grasses, sedges, shrubs grow	Poorly drained, saturated conditions
17	Avalanche debris fields	Steep and rocky thin soils
54	High elevation cirque basins, rockland	Steep and rocky thin soils
55	Low to mid elevation rocky hillsides with sparse forest cover	Rocky thin soils
72	Steep high elevation cirque headwalls and ridges; rockland, talus mosaic with soils	Steep, rock thin soils and short growing season
75	Rock cliffs and limestone areas sparse forest cover	Rocky thin soils and alkali soil conditions that restricts growth

Predicted effects from fuels management

Fuels treatment would continue as a method to reduce fire risk. Prior to year 2000, fuels treatment was primarily a connected action to timber treatment. With the National Fire Plan passed in 2000, fuels treatment intensified steadily in tandem with commercial harvest and as a separate treatment. Fuels treatment also involves managing wildfire for resource benefit since many of the habitats on the forest have not had fire over the last 100 years.

For the past twenty years fuels are treated with a combination of mechanical treatment and predominantly underburning instead of broadcast burning. Figure 8 shows an increase proportionally in underburning over broadcast burn since about the year 1990, but also the dramatic increase in wildfire acres. Broadcast burning removes slash and understory vegetation to facilitate reforestation, but has had negative consequences by consuming the forest floor and leaving scant groundcover. Underburning, on the other hand, results in low and moderate burn severity that retains soil groundcover and forest floor. It is also used in conjuncture with whole tree yarding that removes fuel even before burning. A tradeoff of whole tree yarding, however, is the export of nutrients offsite by removing nutrient rich green foliage.

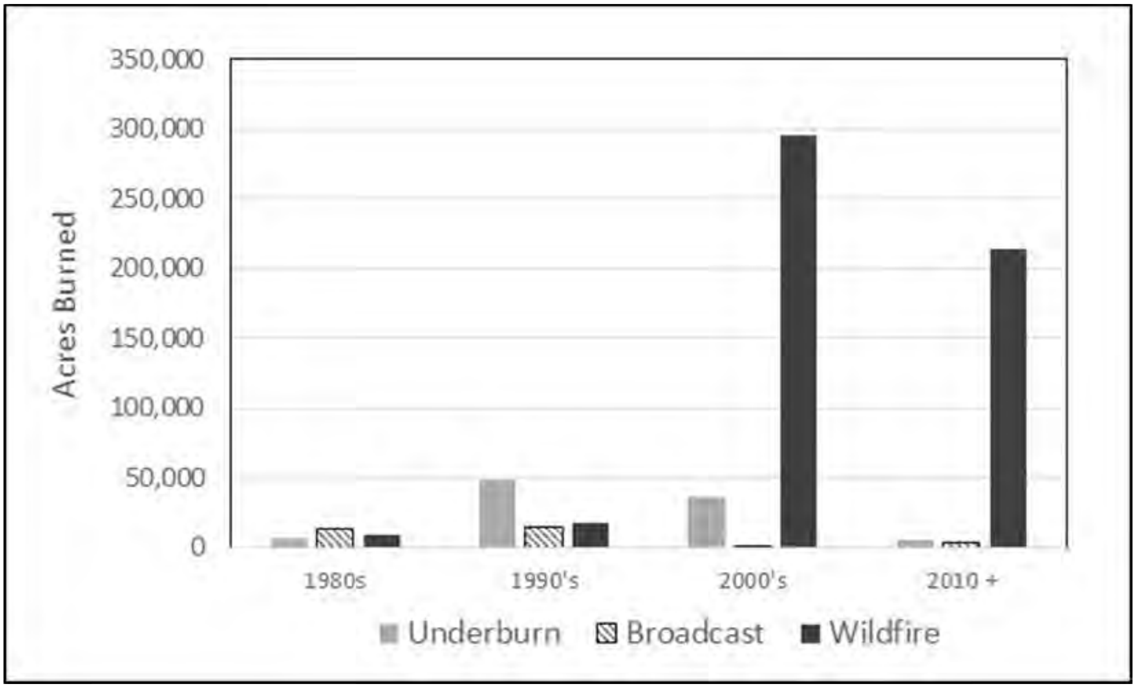


Figure 8. Prescribed and wildfire acres burned over the last planning period.

For the next planning period, the Forest would continue to treat fuels in the wildland urban interface using a mixture of pile burning, mechanical removal and underburning. As noted above the treatment type affects soil condition by removing vegetation that would otherwise decompose in soil and build up soil carbon. The loss of vegetation by treating fuels is not far removed from natural processes since fire regularly removed vegetation by volatizing biomass. However, the impact may vary by site type. Those areas with organic soils in topsoil that grow abundant grasses and forbs on dry sites likely experienced frequent fire. In these areas, treating fuels aligns with ecological processes and the soils have a higher proportional amount of organic matter in the mineral soils to buffer the removal. For other moist types, the fuels treatment may not directly align with natural cycles. Treating fuels temporarily removes dense growth but the moist conditions favor quick regrowth. Repeated removal of vegetation to mitigate fire hazard would be out of sequence with the long periods between fires that these vegetation communities typically experienced. These treatments would reduce vegetation leaf and root litter contributions to soil with overall impacts depending on soil fertility.

One benefit of fuels treatments that re-introduces fire is that the fire can improve soil condition. Burning creates a net increase in available nutrients, both in terms of the products of fire contained in ash residue and the higher decomposition rates after the fire. Almost immediately, burning increases the amount of mineral nitrogen levels for plants and soil organisms (Choromanska and DeLuca 2002, Hart et al. 2005), a limiting nutrient in most forest ecosystems (Binkley 1991). In drier habitats, this increase can be detected as much as 50 years after fire (McKenzie et al. 2004). The burning also increases charcoal production that conditions soils, increasing water holding capacity and providing exchange sites for plants and soils to acquire nutrients (DeLuca and Aplet 2008).

Acknowledging that fuels treatment often requires use of ground based equipment, the Flathead NF would apply the same mitigation as for timber harvest to limit the amount of soil disturbance from equipment travel. The same guidelines as for timber would also apply for retaining a minimum level of soil organic matter and groundcover (FS-GDL-Soil 4). The levels will vary at the project level depending on the fire risk, site type, and soil condition (FW-GDL-TE&V-10).

When comparing the impact of fuels treatment across the alternatives, all action alternatives would lead to greater acreage burned than the current plan by managing wildfire for resource benefit. Active reduction of fuels would likely track with timber harvest with descending treatment as follows: Alternative B, Alternative D and Alternative C. The amount of fuels treatment will be budget controlled, similar to timber harvest activities

Effects from infrastructure

The forest would continue to reduce the road system towards a manageable amount. Over the last twenty years, about 19 miles of road was built while about 787 miles of road was decommissioned. Future road building would likely be confined to realignment, while the main emphasis would continue on decommissioning roads. Where roads are built, the average amount of soil extracted is 3 acres per mile assuming a fifty foot wide prism. The road decommissioning treatment repurposes the road area back to productive landbase and no longer manages these as administrative areas.

The net effect of reallocating more area back to productive purposes would largely be positive. As a means to sustain productivity, the forest will evaluate not only stabilizing these old road areas but prescribe treatments to promote soil recovery (FW-STD-Soil 4).

Reducing management risk for soil erosion

Adequate canopy and groundcover is the best protection against soil erosion. Foliage intercepts rainfall, understory vegetation and forest litter reduce the impact and enhance infiltration through rooting. Overland flow, much less surface erosion, is rare in Rocky Mountain forests (Wondzell and King 2003). Using Disturbed WEPP, a soil erosion model amended for forested environments, soil erosion rarely occurs if groundcover exceeds 85% cover (Elliot 1999). The forest monitoring of soil disturbance shows that in general timber harvest activities do leave extents of bare soil that exceed 10 percent (Milner 2015). Standard practices in addition to new reclamation measures would contain offsite erosion. GDL-Soil 3 would lessen surface soil erosion by ensuring management activities maintain at least 85 percent cover. Use of slash on skid trails is one measure adopted more commonly that increases groundcover and facilitates vegetation regrowth on disturbed soil surfaces.

Managing prescribed fire and wildfire for resource benefit poses temporary risk for erosion/ deposition during at least three years post fire depending on remaining groundcover. After fire, the blackened ground stabilizes as plant cover and roots secure the surface, and loose exposed soil transports downslope. Across blackened areas, the net effect of the burn residue and surface sealing of soil pores can exacerbate erosion potential by slowing infiltration (Wondzell and King 2003, Larson et al. 2009). This post burn condition is highly variable spatially and decreases over time (Doerr et al. 2006). All action alternatives would have similar direction for this fire management.

The proposed Flathead NF plan has, as a desired condition, management not destabilize areas with highly erodible soils or mass failure potential. Most of the erosion issues from road failures associate with either decommissioned or abandoned roads. The Flathead has generally low risk for mass failure overall due to the stable Belt metasedimentary geology. The most extreme failure potential was found in the Skyland/Puzzle Creek area, which the 1985 plan excluded based on environmental analysis in 1974. However, due to current engineering techniques and harvest equipment, the risk would be less than the initially proposed jammer logging in the 1970’s. The main triggers for road failure involve saturating rain on snow events. GDL-Soil-2 guides management to avoid landslide prone areas.

Climate change impacts

The Forest lies along the border of warm maritime climate west coast and cool, dry continental climate from the east. As the climate continues to warm, the outcome may be difficult to predict because of the interaction of topography and the uncertain dominance of the continental versus maritime climate influence. Also, with increasing precipitation, the moisture can buffer rise in temperature so long as there is enough stored water. Shifts in climate could play out mostly in mid elevation forests where winter moisture comes as rain rather than snow, and where a decrease in snowpack could result in prolonged periods of soil moisture deficit. It is likely this would continue the trend of earlier spring, as much as two months over the next century (Luce et al. 2016).

A decrease of snowpack could extend soil drought to the mid elevations that is now common to lower elevation ponderosa pine forests. The seasonal water deficits could stress mesic species such as larch, lodgepole and alpine fir that make up the mixed conifer forests. It is possible drought stress would affect mid elevation forests even more because forest species shift most according to aspect in this zone. Concave slope areas would grow mesic species since these areas have moist deep soils from converging slope water. The upper extent of the timber line would likely move up in elevation as the growing season extends in these normally cold limited environments.

Any future changes to length of growing season would affect soil and plant respiration. Typically, soils become active where temperatures exceed 44 degrees F and decrease activity when soil moisture declines below 10 percent moisture (Davidson et al. 1998). The combination of adequate temperature for growth is expressed as growing degree days. Using a 30 year compilation of mean annual data (Holden et al. 2015) growing degrees vary according to topographic gradient, aspect and valley form for the Flathead NF. Bottomlands can have up to a 220 day growing season except where cold air drainage constrains growth. Middle elevations have from 160 to 200 day growing season varying mostly by aspect. In upper elevations, the cold air temperatures restrict the growing season down to 100 days with the greatest limitations above 7,500 feet. On areas that could experience longer seasonal drought, the effective growing degree days for soil respiration would decrease while upper elevations might have a longer growing season. As warming occurs, available soil moisture will be the primary control at mid to lower elevations. In Colorado, a study found that in complex terrain available water was limiting factor to soil respiration for ponderosa and lodgepole (Berryman et al. 2015). On finer scales the outcome becomes complicated by the interaction of the forest canopy and topographic position. Soil water can be maintained by the shading of forest canopy that reduces evaporative losses from wind and sun, but forest transpiration also draws soil water down.

Cumulative effects

Past actions and foreseeable future actions primarily affect soils in situ. Influence from adjacent management on private, state or federally managed areas would have immeasurable effects on site specific soil conditions. Legacy disturbance from wildfire and timber harvest could affect soil condition where future management is planned.

During the last planning cycle in the 1980's the footprint of forest management was still expanding into new forest stands. At the same time, rules and guidelines were beginning to take into effect to control soil disturbance and limit offsite transport of sediment (Binkley and Brown 1993). The Forest Service had begun working with the state to adopt best management practices that reduced the adverse effects of timber harvest on soil and water.

Figure 9 shows the increased use of forest intermediate cuts (including salvage cuts) relative to stand regeneration over the last planning cycle. The projected levels displayed in figure 9 as blue shading, represent budgeted and unconstrained harvest acres for Alternative D, which has the highest management intensity. During the latter part of the last planning period, forest harvest began to enter stands with prior harvest, usually conducting commercial thins within immature forests. These prior harvest stands had remnant systems of roads and skid trails that could be re-used, but also additively increase the soil disturbance footprint when combined with contemporary harvest. Over the next planning period, re-entry into stands to conduct intermediate harvest will continue. Regeneration harvest in these stands that had prior treatment is not likely since these areas are not projected to grow to commercial grade during the next planning cycle. These regenerated areas would likely receive hand thinning that does not additively increase soil disturbance.

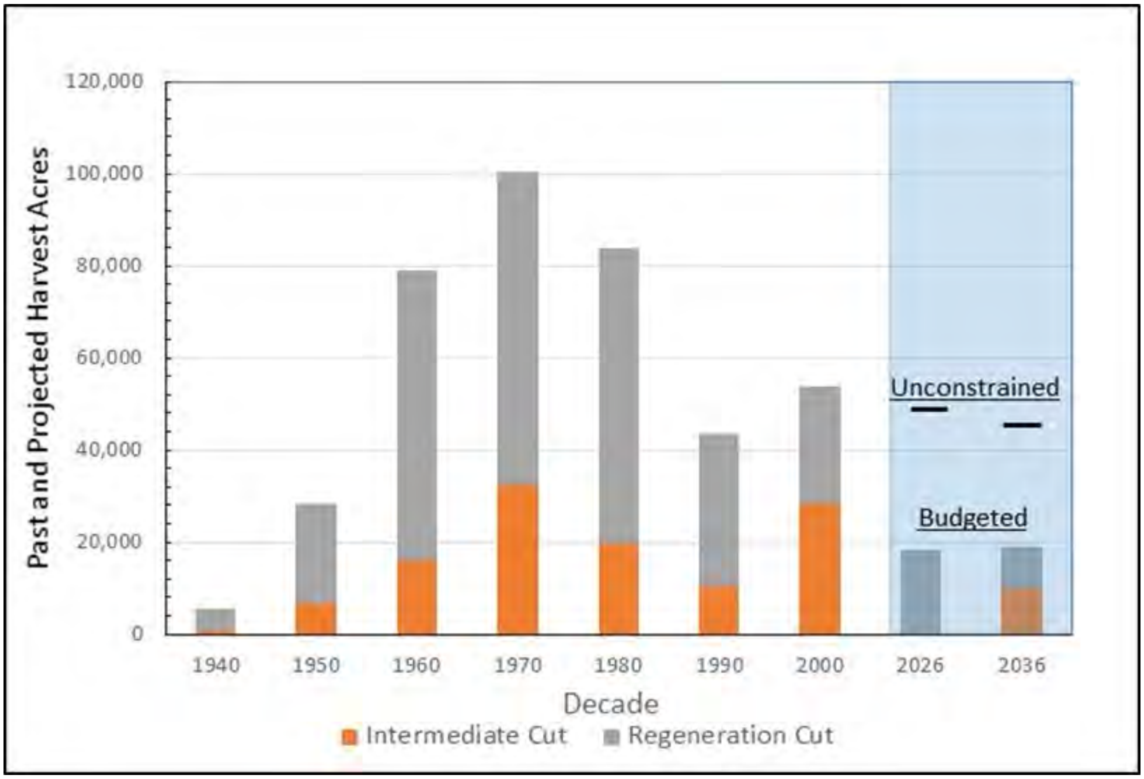


Figure 9. Timber harvest by decade for past and projected Alternative D.

Where new forest treatments have residual effects from past harvest, soil remediation could improve the trajectory of soil recovery. Soil remediation involves actions to obliterate old temporary roads and landing piles, while also conserving organic matter from slash to harness biologic processes for faster soil recovery and overall improved soil quality. Using soil disturbance criteria, the forest plan standard STD-Soil 1 directs to move toward a net improvement in soil quality where current conditions exceed 15 percent detrimental soil disturbance.

Based on recent trends in wildfire and more emphasis on prescribed burning for restorative purpose, more fire is expected to occur during this next planning period. Much of this fire may burn through recovering areas that experienced moderate or severe wildfire. Burning through past fire areas with “jackstrawed” dead trees could produce heat that penetrates deeper into soil because of longer burn duration. There is concern that this heating can sterilize soils and impede forest growth. Research has shown that despite this heating, that reburn rarely sterilizes soil even in re-burn scenarios where concentrated fuels may increase fire severity; rather, the recovery will be controlled by fire severity, tree overstory level, soil texture, and the timing of the burn (Neary et al. 1999, Hebel et al. 2009). The fire may re-organize the soil community where generalist species dominate early on (see

Egerton-Warbuton 2005, Jiménez Esquilín 2008). The soil condition will improve as vegetation recolonizes the site and organic matter stocks rebuild.

3.2.7 Aquatic environmental consequences

Introduction

Surface water, groundwater, floodplains, riparian areas, wetlands, aquatic habitats and other aquatic organisms are all closely related. Discussion of effects on these resources are broken into three separate sections: Watersheds (water quality and habitat), riparian areas, and aquatic species. There is a considerable link in terms of how management may affect water quality and habitat and what that translates to impacts upon aquatic species. For example, increases in roads can lead to increases in sediment reaching streams which could lead to a reduction in water quality, which if high enough could lead to a listing as an impaired water body under the Clean Water Act. That same sediment if high enough could smother fish eggs in the gravel and lead to a reduction in local fish populations. A background discussion is provided first to give an overview of each resource area followed by possible effects discussions if any.

Summary of aquatic environmental consequences—comparison of the action alternatives with the no-action alternative

The Flathead National Forest recognizes the continuing need to provide clean water and high quality fish habitat. As such, the proposed forest plan amends current forest wide direction to reflect BASI, to meet requirements in the 2012 planning rule, and to address previously overlooked gaps in direction. These changes are reflected in the forest wide direction of the revised plan, including the plan components within watersheds, RMZs, CWN, and infrastructure. These effects are the same across all action alternatives.

A key component of current forest plan direction (alternative A) for water and fish habitat are RHCAs. RHCAs are management areas that were designated around all water bodies, wetlands, and streams in 1995 via the INFISH decision. “RHCAs are portions of watersheds where riparian-dependent resources receive primary emphasis, and management activities are subject to specific standards and guidelines” (INFISH, 1995). In the alternatives B, C, and D, these areas have been renamed RMZs and have been changed as described below.

RHCA’s currently cover about 328,000 acres of the Flathead National Forest, and the proposed RMZs will cover about 427,000 acres. This expansion is the result of increasing the size/distance of RMZ areas around wetlands, lakes, ponds, landslide prone areas, and on some intermittent streams. The RMZ distances measured around all other water bodies or features remains the same as current RHCAs direction, e.g. 300 feet on fish-bearing streams, 150 feet on perennial non-fish bearing streams, etc.

Along with the name and size changes, the direction applicable to RMZs would change under alternatives B, C, and D. Research in recent years (Benda et al 2015) has documented that it is possible to use active RMZ management to advance riparian condition while preserving the functional attributes for riparian and aquatic resources and water quality. With alternatives B, C, and D riparian standards are designed to restore, enhance, and maintain riparian ecological functions and aquatic species habitat, while limiting activities that create long-term degradation, such as road building and clearcutting. The proposed RMZ standards establish a differentiation between the inner and outer portions of RMZs with regard to limitations on vegetation management (FW-STD-RMZ-01, 03, 04). Management of the inner RMZs would remain expressly for the purposes to conserve riparian, fish and aquatic resources, while the outer RMZ would allow for other management objectives as long as they did not create long-term degradation to riparian and aquatic conditions. This change is expected to maintain, restore, and enhance riparian condition by moving from a protective or passive RMZ management to an active restoration strategy. While this type of management was feasible under the current direction, the proposed standards were developed to explicitly recognize that RMZs can benefit from active management and that the areas closest to water have greater importance for protection of water quality and aquatic resources.

The four RMO categories applicable to forested systems are pool frequency, water temperature, large woody debris, and width/depth ratio. The PIBO monitoring effort systematically collects RMO data across Forest Service Regions 1, 4, and 6. In addition, the PIBO monitoring effort set also collects sediment data, which was not included as an INFISH RMO. With over a decade of consistently collected data and improvements in data analysis, PIBO data can be used to compare between managed and reference watersheds on an individual National Forest scale. PIBO monitoring best meets the original intent of INFISH RMO's by providing rigorously collected local data that can be statistically compared to reference conditions in the same geophysical province. Alternatives B, C, and D require aquatic habitat monitoring and desired condition monitoring based on data collected in the PIBO monitoring effort, and no longer references the interim RMOs established by INFISH.

In alternatives B, C, and D, standards and guidelines from INFISH were updated to reflect the definitions and requirements of the 2012 planning rule. Instead of the standard from INFISH to complete a watershed analysis prior to constructing new roads or landings within RHCAs (RF-2a) and prior to salvage cutting in RHCAs (TM-1a), a project-level NEPA analysis for activities that propose entry into the RMZ would consider a multi-scale analysis as described in appendix C.

Adapting the current direction to the 2012 planning rule also required a look at BASI and triggered a reassessment of current direction. The forestwide plan components with alternatives B, C, and D include numerous changes that would alter management on the Forest to address the detrimental effects of roads on water quality, wetlands, riparian areas, and aquatic species. While INFISH dramatically amended forest and road management on the forest, the proposed forest-wide plan components found in alternatives B, C and D would further improve and advance the protections by increasing RMZ widths of intermittent streams and wetlands, by better integrating the wildlife connectivity needs, and instead of relying upon numerical standards to describe habitat conditions considers stream processes and functions consistent with the 2012 planning rule.

3.2.8 Watersheds—water quality environmental consequences

Effects of forestwide direction on water quality—alternative A

The Inland Native Fish Strategy (INFISH)(USDA 1995), as it was amended to the Flathead Forest Plan in 1995, is unchanged from its original wording in Alternative A. INFISH reduced the risk to watersheds, riparian and aquatic resources by improving riparian zone protections. INFISH has standards and guidelines for timber, roads, grazing, recreation, minerals, and fire management that has improved water quality on the forest. As mentioned above, the year after the implementation of INFISH, there were 22 streams on the forest that were listed as impaired due to siltation. During the TMDL development for streams on the forest from 2004 to 2014 no TMDL was required for 17 of those streams because data collected to support TMDL development indicated that they were no longer impaired for sediment and were removed from the 303(d) list without a required TMDL (MDEQ 2014). In other words sediment which was a leading factor towards impairment was no longer impacting beneficial uses. The implementation of INFISH direction along with BMPs, reduction of road construction and a reduction of timber harvest along streams due to RHCAs likely helped reduce sediment delivery.

Effects of forestwide direction on water quality—alternatives B, C, and D

For Alternatives B, C, and D changes were incorporated to improve implementation of riparian measures while maintaining the intent of INFISH which provides for "healthy, functioning watersheds, riparian areas, and associated fish habitats." The primary changes in action alternatives are some changes in standard and guidelines, replacing the requirement for watershed analysis with a multi-scale analysis commensurate with the potential effects of the project being proposed, and replacing numerical Riparian Management Objectives with process specific plan components that guide project development. Monitoring for desired condition attainment will be tracked using the database developed from the Interior Columbia Basin Monitoring Strategy that resulted from the PACFISH/INFISH Biological Opinion's. Since 2010, additional methodologies have been developed that allow comparison between managed and reference stream conditions on National Forests (Al-Chokachy 2010). These methods will be utilized in Plan monitoring.

Plan components for aquatics do not vary between action alternatives, therefore the effects of the plan components on aquatic and riparian resources vary between alternatives based solely on the changes in management areas and the projected amounts of land management activities, which will be discussed in more detail. The standards and guidelines that in the action alternatives were designed to protect riparian and aquatic resources based upon past monitoring. The most significant change between action alternatives and the existing plan (Alternative A), is the incorporation of forest wide standards and guidelines that are specifically designed to protect aquatic resources. If all applicable measures are implemented and if they are effective, watershed conditions would be expected to improve.

All streams with assigned TMDLs would receive special emphasis to improve water quality conditions under all alternatives due to the Forest Service's legal obligation to meet requirements under the Clean Water Act. For the action alternatives, this obligation has been combined with a Forest-wide guideline to contribute to and be consistent with TMDL implementation plans (FW-GDL-WTR-01) and striving for water quality that meets or exceeds state water quality standards and fully supports beneficial uses (FW-DC-WTR-06). This direction should help improve water quality conditions within the Flathead National Forest and assist in achieving conditions needed for these streams to fully support their beneficial uses. All action alternatives propose to implement restoration in impaired watersheds per the developed TMDLs (Logan, Sheppard, Coal, Goat, and Jim creeks). The rate and effectiveness of active restoration combined with the emphasis on 303(d) listed segments could shorten the time for bringing 303(d) waters into compliance over Alternative A. An assumption might exist that Alternative C, due to more designated wilderness, would be least likely to lead to further impairment of waterbodies, however, the standards and guidelines set forth in all action alternatives will protect streams from impairment and it is not anticipated that any streams would be designated during the length of the plan.

Activities that disturb the soil surface have the greatest potential to adversely affect these resources if they occur in proximity to stream channels. These effects are typically expressed as inputs of fine sediment where activities occur along stream channels and have an associated crossing or other surface disturbances. Watersheds whose physical, chemical, or biotic function is at risk may be near their capacity to assimilate further impacts, or may need remedial action to reverse a downward trend. Therefore, alternatives that propose higher levels of land disturbing activities such as alternative D pose greater inherent risks to aquatic and riparian resources unless the standards and guidelines assure protection. Monitoring will determine the effectiveness of the standards and guidelines at protecting riparian and aquatic habitat.

Nearly all the implementation of land management direction carried out on the forest and described in this analysis have the potential to adversely affect aquatic and riparian resources to some degree. Activities that alter the quantity, timing, or quality of water resources have the greatest potential for adverse effects, and the risk of adverse effects generally decreases as the distance away from streams or wetlands increases.

Watershed conservation practices, Best Management Practices and forest plan standards and guidelines prescribe extensive measures to protect soil, riparian, and aquatic resources. When applicable measures are implemented and effective, adverse effects to these resources from management activities will be minimized or eliminated.

Implementation and effectiveness monitoring of Best Management Practices are performed primarily through three administrative processes: the biennial Montana State Forestry Practices BMP review, forest plan monitoring , and the Forest Service's National BMP Program (USFS 2012; Draft FSM 2532 http://www.fs.fed.us/biology/watershed/Draft_FSM_2532.pdf). During the 2014 Montana BMP review, the forest practices BMPs applied on federal lands, including National Forest System and Bureau of Land Management lands, were found to be over 96% effective at preventing impacts to water quality (Ziesak 2015). Implementation and effectiveness monitoring of watershed conservation practices, and forest plan standards and guidelines can be carried out by a variety of personnel including timber sale administrators, contract officer representatives, resource specialists, and line officers. Documentation of this monitoring can include field notes, memos, contract daily diaries or monitoring reports. Systematic monitoring and adjustment of land management activities, where necessary, will ensure the highest possible level of Best Management practice implementation and effectiveness.

Effects of additional recommended wilderness on water quality

Background

Areas of minimal human development such as recommended wilderness are often sources of high-quality runoff (Brown and Binkley 1994), and the importance of such water will increase as development proceeds. In general, the same can be said of wilderness areas, which typically provide the highest quality water. Surveys by Hass et al. (1986) and Cordell et al. (2008) indicate that, of the many reasons for the high valuation of wilderness by citizens, protection of water quality consistently receives the highest ranking.

The general high quality of wilderness water can be attributed to the lack of the activities, development, and pollution sources such as roads and timber harvest. However, there are not any studies that explicitly compared water quality data from within and outside of designated wilderness lands or similarly managed areas. There is habitat data from PIBO for managed versus reference streams and much of the data for reference streams is from with wilderness areas. Many of our managed streams have habitat conditions similar to reference streams (Kendall 2014).

Alternative A

The current forest plan as amended proposes 98,388 acres of recommended wilderness. The areas that are recommended are high elevation and will protect headwater habitats that will provide cold clean water downstream to fish and habitat. Alternative A will continue to provide long term protections but not as much as alternative C.

Alternative B, C, and D

The overall effect of recommended wilderness areas, especially in Alternative C, is expected to be beneficial to water quality and quantity because of the limitation on land management activities. However, these acres are currently managed as Inventory Roadless or as grizzly bear security core and there is no active management so impacts to water resources have not occurred. Recommending these areas will assure that wilderness character is maintained and will provide protection of habitat conditions. Designation of recommended wilderness will assure that these areas will not have activities that would negatively impact wilderness character unlike alternative A where helicopter logging could occur for example. In addition, the number of stream miles located within recommended wilderness boundaries are increased over the existing condition. By altering wilderness boundaries to include hydrologic divides, aquatic habitats are expanded from the existing condition by increasing the amount of stream miles that are afforded additional protection under wilderness designation. By extending the downstream lengths of stream segments that are located within existing wilderness, aquatic biota, especially native cutthroat trout, benefit from management designation that precludes activities that may have a detrimental effect in some instances and from the additional protection (e.g. MTDEQ Class I waters) afforded streams located within wilderness areas. The difference here versus 303(d) streams above is that wilderness designation affords the ultimate protection to aquatic resources while standards and guidelines will assure that impairment will not occur that may lead to a 303(d) listing. Alternative A will continue to provide long term protections, but not as much as alternative C. Alternative D would be the least beneficial alternative for protecting water quality and quantity within recommended wilderness areas as none is proposed.

Effects on water quality from livestock grazing

Background

Improper livestock grazing can have numerous direct and indirect effects on soil infiltration by trampling, soil compaction and loss of vegetation cover on both upland and riparian sites. Fecal wastes can increase bacterial concentrations in water through direct introductions into live water or riparian areas. Soil and water quality can be indirectly affected by the resulting increased soil runoff and erosion, and sediment delivery to adjacent riparian areas and streams. Impacts are often greater in riparian zones because they are preferred by livestock due to the availability of shade, water and more succulent vegetation. Over long time periods, grazing can result in increased fine sediment loads from stream bank erosion, loss of riparian habitats by stream channel widening or degradation, and lowering of water tables, through channel degradation.

Overgrazing by livestock can reduce bank stability through vegetation removal and bank trampling, it can compact soil, increase sedimentation, cause stream widening or downcutting and often changes riparian vegetation, resulting in insufficient overhead cover for fish (Platts 1991). Stream widening and sedimentation can reduce instream cover and habitat quality for fish through mechanisms similar to those described for vegetation removal by timber harvest or fire, but grazing impacts can be compounded by repeated yearly use of the same areas by livestock.

Alternative A

There are nine active allotments on the Forest. Seven of the nine allotments have been inactive for periods over the last five years so exposure to detrimental effects on watersheds have been limited. Monitoring of allotments over the last decade has shown some bank alteration and reduction in stubble height. In addition, there is elevated percent fines and D50 as monitored at the PIBO locations. Alternative A would continue to have a minimal effect on watersheds as a whole however, localized stream impacts may continue to occur unless stream sections are fenced.

Alternatives B, C, D

Forest-wide standard and guidelines would protect and minimize the effects of grazing on aquatic resources in all action alternatives. There are three guidelines specific to grazing (FW-GDL GR 3, 4, and 5) that would help to reduce impacts on water quality. These guidelines would reduce bank trampling and minimize livestock operations within RMZs. Reducing the length and timing of the grazing season in RMZs allows for more growth of grasses and forbs which capture overland flow and prevent rills from forming and prevents erosion from delivering sediment to water bodies, thereby lowering turbidity and fine sediment deposition in the water body. It would also reduce potential bacteria such as E. coli that has been shown to affect nutrients.

Watershed conservation practices and updated grazing standards and guidelines designed to protect water quality and riparian areas and would be included in allotment-management plans as they are revised and updated.

Monitoring has shown that the proper implementation of livestock grazing standards adopted from INFISH (alternative A) has led to improved stream conditions and that trend is anticipated to continue under the action alternatives. There will be no differences in effects between action alternatives other than Alternative D may create more transient forage since more land is in MA6, however the forage would be away from the creeks due to limited harvest within the RMZs. Existing allotments are in MA6b and 6c.

Effects on water quality from minerals and oil and gas

Background

Locatable minerals

Locatable or hard rock minerals include deposits of gold, silver, copper, etc. There were approximately 63 patented and unpatented mining claims on the forest according to the Montana Bureau of Mines and Geology. A 2002 MBMG report found that the Big Four Mine on the Swan Lake Ranger District near West Fork Dayton Creek was the only site identified on the Flathead National Forest that had potential impacts on FNF-administered land. Water-quality samples collected in 2000 upstream and downstream of the site indicated no adverse impacts. That mine is no longer active and the only active mining claim located within the planning area is the Mary Dee II lode claim is located in the Hungry Horse Ranger District.

There are no existing mining operations on the forest. Recreational mining, like suction dredging, may occur although the forest has not received requests for special use permits. Suction dredging is regulated by federal and State mining laws and regulations. Montana DEQ has closed many of the forest's bull trout and cutthroat streams to suction dredging, therefore impacts will not be seen in those streams. Large increases in mining activity are not anticipated for the future, but cannot be ruled out. The 1872 mining law limits Forest Service authority over mining activities, but allows the setting of terms and conditions to minimize impacts to NFS lands. All alternatives will require remedial action and protection of soil and water resources if permits are approved.

Leasable minerals (oil and gas)

The Flathead River Basin contains Federally-owned subsurface mineral estate under National Forest System lands that the Federal government has leased for oil and gas development. At the time legislation was initially proposed in 2010, there were 115 oil and gas leases in the North Fork watershed that the BLM issued between 1982 and 1985. The leases, which cover over 238,000 acres, are inactive and under suspension as part of the 1985 court case *Conner v. Burford*. At the request of

Montana Senators Max Baucus and John Tester, leaseholders have voluntarily relinquished 76 leases consisting of almost 182,000 acres. The BLM has not offered any other leases in the Flathead National Forest since the *Conner v. Burford* litigation suspended the existing leases in 1985.

The North Fork Watershed Protection Act of 2013 (H.R. 2259) withdrew Federal lands (430,000 acres) within the North Fork and Middle Fork Flathead watershed from all forms of location, entry, and patent under the mining laws and from disposition under all laws related to mineral or geothermal leasing. H.R. 2259 does not affect valid, existing rights, including the 39 leases in the North Fork watershed that are suspended under the *Conner v. Burford* litigation.

Salable minerals

Salable minerals include common varieties of sand, stone, gravel and decorative rocks. The Forest Service salable mineral material policy (FSM 2850) states that disposal of mineral material will occur only when the authorized officer determines that the disposal is not detrimental to the public interest and the benefits to be derived from proposed disposal will exceed the total cost and impacts of resource disturbance. The forest uses materials such as gravel, riprap, and crushed aggregate for maintenance and new construction of roads, recreation sites and repair of damage caused by fire, floods and landslides. These materials come from forest service pits and quarries. The type, volume, and source location of in-service mineral material varies year-by-year and according to need. Free use permits can be issued to any state, federal or territorial agencies, unit or subdivision. As an example, the Glacier View Ranger District has issued crushed stone to Flathead County for maintenance and improvement of the North Fork Road. Free use permits can also be issued to the general public. Each individual may obtain a free use permit to collect rock, as long as it is not for commercial use, sale or barter. Only hand tools can be used to collect the rock, no digging is permitted and collection of only loose rock is authorized. Usually around 75 permits are issued each year.

Alternatives A, B, C, D

There are no active leases on the forest and no effect on watersheds, fish or riparian areas from any of the alternatives. Generally, gravel pits are situated away from riparian areas and tend not to have watershed or riparian impacts. There are no effects on fish, watersheds, or riparian areas from any of the alternatives from the free use permits to the general public.

Effects on water quality from recreation

Background

General effects from recreational use, construction, and maintenance to watershed resources can include undesirable changes to: (1) upland and riparian soil and vegetation conditions, causing increased erosion and runoff, decreased soil-hydrologic function, loss of vegetative cover and wood recruitment, and reduced water quality; (2) stream morphology, water quality, streamflow, and substrate; and (3) water quality from spills of fuel, oil, cleaning materials or human waste associated with equipment, and the pumping of toilets.

Non-motorized and motorized watercraft use can “disturb” or “stress” adult and juvenile fish. Typical activities associated with non-motorized use include floating, wading, and swimming in areas where fish are holding, rearing, or spawning. Studies conducted on the Rogue River have shown that juvenile salmon and steelhead passed by non-motorized watercraft exhibited both behavioral and physiological signs of stress (Satterthwaite 1995). The energy expended by juvenile salmonids reacting to passing watercraft may result in a reduction in energy available for growth and development. A decrease in available energy stores may also reduce their effectiveness in competing for food, defending territories, or spawning.

Streambank trampling, camping along the stream's edge, heavy fishing, and off-road vehicle use usually result in the loss of vegetation within riparian areas. Loss of vegetation from shorelines, wetlands, or steep slopes can cause erosion and pollution problems (Burden and Randerson 1972, Quigley and Arbelbide 1997).

Trail maintenance can affect large wood recruitment and function that influences stream channel morphology and aquatic habitat. Bucking out fallen trees can reduce the tree's length and sever the bole from its root wad. Smaller tree lengths are not likely to contribute as much to stream channel stability and are more likely to be washed out during high stream flow events. Smaller instream wood will also delay the recovery of channel features needed to maintain habitat for aquatic species, including overhead cover and low-velocity refugia during high-flow events.

Recreational impacts may include rutting, erosion, and loss of ground cover from user trails, trampling of vegetation, vegetation removal, and soil compaction of streamside and upland sites. Rutting may increase surface erosion associated with heavily used hiking or horse trails and off-road vehicles. High use campsites may cause root damage in trees resulting in reduced vigor and mortality.

In general, people who recreate in national forests participate in activities such as driving, hiking, horseback riding, hiking, and camping in the vicinity of lakes and streams. Protection of water quality, quantity and riparian habitat near these recreationally important water bodies is achieved through the implementation of Watershed Conservation Practices.

Recreational activities can degrade aquatic, riparian, and wetland environments. Because many existing, trails, developed and dispersed recreation sites on the forest are located adjacent to wetlands and riparian areas, or in some cases, within the flood prone areas of streams, these sites have been subjected to the following impacts: damage to and displacement of riparian vegetation; soil compaction and soil erosion; increased rates of overland flow; sedimentation; and pathogenic contamination of potable and non-potable waters. Often, the aforementioned impacts tend to be localized, however, in areas that experience substantial recreational use, the cumulative impacts to aquatic and riparian ecosystems can be both observable and measurable.

Recreational use will almost certainly increase in the coming decades. Projected increases in recreational use are commensurate with all alternatives. Watershed conservation practices implemented to protect aquatic and riparian resources notwithstanding, impacts to these resources will likely increase given increased use because stream and lake environments will continue to disproportionately attract forest users.

Alternative A

INFISH amended the forest plan in 1995 and provided three standard and guidelines for recreation management mainly relocating or constructing new developed and dispersed sites outside of riparian areas. No developed recreation sites have needed to be relocated due to adverse impacts to fish. Most dispersed and developed sites are located within riparian areas; the ground is often hardened and ground vegetation may be removed however, we have not identified areas where excessive sediment from these sites is a concern. Dispersed sites typically do not have toilet facilities and we have found concentrations of human waste at some locations. Impacts are isolated and we do not see no monitoring has been performed to identify impacts to water quality parameters. Trees have been felled for safety reasons in campgrounds and will continue to be felled for safety reasons. Under current direction, these trees would be removed or chopped up for use as firewood and would not contribute to instream bank stability, thermal regulation, or fish habitat needs. Once again this impact is limited to developed recreation sites in nature and PIBO monitoring does not show that large wood is limited from our streams. Alternative A would continue to address recreational activities which have not been shown to contribute impacts to watersheds.

Alternatives B, C, D

Two new standard and guidelines were designed and included in the action alternatives to mitigate the effects from recreation facilities that are located within RMZs. FW-GDL-REC-07 will ensure the placement of new facilities or infrastructure are located to minimize impacts on water and riparian resources, and FW-GDL-REC-08 will direct the forest to address impacts from existing recreation facilities located in RMZs, including impacts on water quality in fish-bearing waters.

However, it is assumed that minor, localized impacts to, riparian vegetation, woody debris, and water quality would still occur where recreation use and activities are allowed. Existing recreational facilities and actions within or affecting RMZs may need to be modified, discontinued, or relocated if they are identified as not fully meeting functional aquatic/riparian conditions and processes, or improving conditions and processes. Modification or relocating facilities may cause temporary affects to streams and riparian areas. Where facilities cannot be located outside of RMZs, effects would be minimized to the greatest extent possible, but not completely eliminated.

Effects on water quality from motorized and non-motorized winter recreation

Background

These winter activities have relatively low to no potential to adversely affect aquatic and riparian resources. Winter recreational use, however, may not be totally environmentally benign. Non-motorized winter uses include cross country skiing and snowshoeing. Motorized winter uses include snowmobiling and converted motorcycles for snow use. Damage to vegetation and soil erosion may occur if there is inadequate snowpack to protect these resources. Also, winter motorized activities can result in compacted snow from grooming which often forms barriers that alter spring runoff patterns which can result in soil erosion and gullies. Snow plowing should provide breaks in snow berms to allow for water to run off road surfaces rather than down them.

Contamination by petroleum products such as motor oil and gasoline may degrade water quality in waters adjacent to areas of concentrated use such as parking lots and snowmobile staging areas. The likelihood and magnitude of the aforementioned impacts due to these activities are dependent on site-specific factors such as average slope, aspect, elevation, vegetation, weather conditions, available facilities, and the amount of use. Because site conditions vary, and because these sites are relatively small in area and widely dispersed, it is reasonable to assume that cumulative impacts will not be measurable at the forestwide scale. Appropriately, winter activities that appear to be problematic will be identified and rectified during project-level analysis.

Alternatives A, B, C, D

The forest has identified very few impacts from winter recreation on water quality, quantity or habitat. An old bridge used to accommodate groomers collapsed in Challenge Creek in the mid-1990s and plugged the channel. This situation was easily remedied by removing the footing and installing a larger bridge. The forest has also seen water running down groomed or plowed roads where breaks were not established in the berms to dissipate the water. This resulted in some localized gullying but no identifiable impacts to water quality. Effects would be the same between all alternatives. There would be little to no effects on watershed resources largely because winter use does not result in ground disturbing activities as it occurs over snow.

Effects on water quality from developed winter recreation

Background

These sites may adversely affect watershed resources. Whitefish Mountain Ski Resort and Blacktail Ski Resort operate under special use permits. Ski area development can lead to increased runoff and erosion through timber clearing for lifts, runs and other facilities. Ski areas and snow resorts typically remove forest vegetation from much of the area. Snowmelt runoff is increased, especially when cleared areas are compacted or snowmaking has artificially increased the snow depth. Substantial amounts of such disturbances can increase the size and duration of spring high flows. Stream channel damage can result. Ski areas and snow resorts also typically disturb soils throughout cleared areas. Erosion and sediment can result, especially from soils that are near streams, unstable, or highly erosive. Aquatic habitat can be damaged as a result. In addition, these uses can also degrade wetlands and riparian areas by draining or filling them or by altering their vegetation.

Alternatives A, B, C, D

Past effects have been identified with regards to operation of developed winter sites. For example, Big Mountain uses groomers that have concentrated snow in the headwater tributaries of Big Creek. A culvert below Chair 7 plugged and partially failed as a result which led to increased sediment entering the stream. Impacts from these types of activities are highly localized and few in nature but they can and do occur at times and can be prevented through proper monitoring and sizing of culverts. All alternatives would continue to permit the existing ski areas as well as cross country ski areas at Round Meadows and Izaak Walton. Effects would be the same between all alternatives as there are no new standards or guidelines that would address how these sites are managed in terms of watershed conditions. There would be localized and few effects on watershed resources because there is little ground disturbing activities. .

Effects on water quality from hiking and stock (non-motorized) trails

Background

Hiking and stock trails are popular among forest users on the forest, though trail networks and trail use can adversely water quality. Trails can provide relatively easy vehicle access and opportunities to those who would introduce exotic species into aquatic environments. Given the popularity of trail networks among forest users, it is reasonable to expect increasing demands by the public for additional hiking trails over the coming decades. If those demands are met, the expanded trail networks could result in the alteration and degradation of water resources.

Demand for a variety of recreational opportunities will continue to increase on the forest whether there are adequate recreational facilities to meet the increased demand, or not. If facilities are insufficient for developed recreation, then recreational use may be shifted to dispersed sites, the result of which could be additional and unregulated deleterious effects on soils, vegetation, and riparian values. Recreational use is expected to increase in all alternatives and impacts are anticipated to be the same between alternatives as non-motorized trails generate very little sediment and they are often located on a ridge leading from a trailhead to a higher location with a view.

Alternatives A, B, C, D

Trails typically have very little impact on water resources relative to roads. The forest does see sediment and erosion from trail use that mainly gets routed into the forest with no impact to water quality, however, it can be routed to stream crossings as well. There are time when trails have slumped into streams due to their location paralleling a stream and not due to their use. Wildfires as well as high flow events have washed out trails both inside and outside of wilderness areas. Once again these impacts are localized and do not result in watershed scale impacts. Guidelines FW-GDL-IFS-03 and 06 are designed to minimize sediment input by assuring that water bars are in place and reduce the risk of slumps therefore any potential pollutants such as sediment, nitrogen and phosphorus are routed to the forest floor rather than the stream network.

Effects on water quality and quantity from travel management and roads

Backgound

Road networks have been shown to have detrimental effects on water and aquatic resources in forested landscapes. Road systems can change a natural hydrologic regime by altering natural flow patterns and increasing sediment delivery to streams. Roads have been shown to destabilize side-casted material and hillsides, expand the lengths of gullies and stream channels, increase sediment delivery, and alter streamflow and channel adjustments (Megahan 1987; Furniss et al. 1991).

Natural drainage patterns are affected long-term by the mere presence of roads. Roads intercept subsurface drainage in cutslopes, capture rainfall on hardened road surfaces, and route excess runoff into the stream channel system. These impacts increase as the road system becomes more connected, in terms of hydrology, to the natural channel network. Where a dense road network is well connected to the stream network, it can be an “extension” of the actual stream network and alter streamflow regimes. These alterations can increase the delivery of water to the mouth of a watershed during snow melts and storm events, which can increase peak flows in streams and water levels in ponds, lakes, and wetlands.

Sediment from the road system can be delivered to streams by direct erosion of cut and fill-slopes associated with stream crossings or by surface runoff from roads and ditches that carries sediment-laden water directly or indirectly to streams. In general, roads lacking surface rock, those with steep grades and steep sideslopes, and those that cross streams or are in proximity to streams are the greatest contributors of sediment from surface erosion. In steep terrain, roads can increase the rate of hill slope failures and soil mass wasting. Excessive fine sediment loading can lead to changes in channel morphology and water temperature because of pool filling, widening of the channel, and making the channel shallower, which can result in water temperature increases as a result of having a shortened water column that takes less solar energy to heat. Such changes in channel morphology are typically found at road-stream crossing locations and in response to mass failures associated with road runoff. Sometimes roads capture flow out of the channel and result in the stream re-routing down the road, which typically results in road failure and more sediment delivery to streams.

Vehicular traffic also contributes to sediment delivery from roads, particularly if ruts develop in the road and if traffic is heavy during shoulder seasons when the ground is more saturated. Log haul during timber sales is typically down the same road system for weeks or months at a time, thus the quantity and repeated nature of this traffic make it a systematic, recognizable source of sediment on forest roads.

The location and design of valley bottom roads also create long term effects on water resources. Poorly placed roads can encroach on stream channel and floodplain areas. Many older roads were constructed very close to stream channel areas, often in the floodplain. Often streams were straightened to accommodate road placement. Roads can affect stream channels directly if they are located on active floodplains or directly adjacent to stream channels. For example, a road located adjacent to a stream can be a chronic source of sediment. If the road changes the morphological characteristics of the stream, this can set forth a chain reaction of channel adjustments that can result in accelerated bed and streambank erosion, which produces excessive sediment.

Not all sediment production from roadways reaches the aquatic system. Many of the aforementioned effects of roads can be mitigated by design changes that disperse, rather than concentrate road runoff. Properly designed and maintained road treatments can decrease runoff and sediment loading to streams. Good design provides stable cut and fill slopes and adequate drainage that allows water to filter through vegetated strips or sediment traps before entering the stream channel. The effectiveness of these vegetative strips generally increases with increased width and lower hillslope gradient, however the effects of large-scale or chronic road impacts may still impact streams even when streams are protected by wide and intact vegetative strips. Other design elements used to mitigate road interception and runoff are the addition of gravel surfacing and seasonal road closures. Road treatments can upgrade or remove problem culverts to allow sediment and wood to move downstream instead of accumulating upstream of roads and leading to culvert blockage and failure. However, temporary, short-term, and long-term sediment and turbidity increases can occur from project implementation, as well as from post-project stabilization.

Turbidity and sediment increases result from the construction of roads, road grading, ditch cleaning, culvert replacement, road ripping or decompaction, and the installation of waterbars due to the heavy equipment excavation that these activities require. Minor amounts of fine sediment would be delivered to streams during implementation of road treatment activities and during the first substantial runoff event. Subsequent runoff events would contribute less sediment production over time but are expected to last up to one year later or until vegetation is established on bare-soil areas adjacent to streams. Design criteria and Best Management Practices are used to minimize the amount of fine sediment entering stream channels while work is in progress and after the work is completed, including promoting vegetation establishment through seeding.

Roads that are at high risk of failure and have the potential to cause extensive resource damage are candidates for relocation or decommission. Preferred locations for roads are away from stream channels, riparian areas, steep slopes, high-erosion-hazard areas and areas of high mass movement. Realignment of roads so they traverse riparian areas and streams at perpendicular angles rather than parallel angles would improve the quality of riparian and aquatic habitats in presently impacted stream reaches by reducing chronic sediment sources. If relocation is not possible, seasonal restrictions could limit road damage and subsequent sedimentation.

The potential risk of detrimental effects exists as long as the road is retained. The continued use and existence of roadway segments poses a risk of erosion, slope failure, and sediment delivery to receiving waters. Road decommissioning reduces the long-term risk of sediment delivery to streams from roads and road-side ditches through reducing culvert failures and landslides, eliminating vehicular traffic, improving infiltration of water into the ground through decompaction of road surfaces, and reducing overland and ditch flow into streams. While some sediment is expected to be delivered to streams during culvert removal and decommissioning processes, the amount of sediment delivered to streams is expected to be significantly less than would occur if the roads were left under current maintenance. Cook and Dresser (2004) found that stream-crossings that were restored through decommissioning delivered only 3 to 5 percent of the amount of fill material that was originally located at each crossing.

Removal or closure of roads adjacent to streams can have a short and long-term positive effect on soil-hydrologic function, soil productivity, and stream water temperature. Trees and other riparian vegetation can re-colonize a ripped roadbed and help provide shade. How much water or stream temperature improves depends on the existing stream shade to block solar radiation and water temperature, the stream's size, and how much riparian road is removed or closed.

The road network on the Flathead National Forest affects water and aquatic resources on both a short and long term basis. There are about 3,595 miles of identified motorized roads open to the public (2,157 miles) and administrative use (1,438 miles) within the forest administrative boundary, including roads managed by other entities such as state Highways, a variety of county roads, federal/state land management agencies, and private timber companies. Of these miles and within the administrative boundary, there are 1,399 miles of NFS roads open to the public, and 1,168 miles of NFS roads used administratively. There are another 1,020 miles of road that are closed to vehicular traffic, of which 956 miles are NFS roads (ML 1). In total, there are about 4,615 miles of road within the forest boundary. There are also about 194 miles of motorized trails under forest management. Across all of these motorized routes, approximately 607 miles of roads and 18 miles of motorized trail are located within RMZs, and there are over 3500 road-stream crossings. These routes located closest to water resources provide a background level of disturbance that contributes to direct and indirect effects on aquatic and riparian resources.

Past culvert failures and road slumps have impacted water quality of the Flathead National Forest, particularly at the site-scale. The Forest Service has jurisdiction (NFS roads) over approximately 3,627 miles of roads, 3,525within the forest administrative boundary, including the 956 miles of road that are closed to vehicular traffic. Forest roads that are maintained on an annual basis are typically those roads that have the most administrative and visitor use. In 2015, 494 miles of forest system road were maintained, which included 73 percent of the roads suitable for passenger cars (ML 3-5) and 16 percent of the roads open and suitable for high clearance vehicles (ML 2). Closed roads receive no maintenance, and not all of these roads were put into long-term storage and had culverts removed. There are over 1,500 stream crossings located on closed forest service roads with some culverts remaining that are no longer receiving regular maintenance.

Alternative A

Standards and guidelines from INFISH and the current forest plan would be carried forward in Alternative A and would continue to require fish passage, upsizing of culverts to pass the 100-year flow plus sediment and debris on non fish-bearing streams, and the application of BMPs, all of which would be beneficial for water quality. Detrimental effects to water quality would continue to occur when culverts fail or roads slump, and unmaintained roads and stream-crossing culverts pose the greatest threat to water quality impacts.

Portions of the Forest Service System road network will be treated to repair and improve drainage structures, improve the running surface of the road, and to clear vegetation along roadsides. Road maintenance is expected to continue at similar levels or slightly decreased levels compared to more recent management. Short-term increases of sediment delivery to streams and water bodies is expected as a result of road surface grading, and culvert and ditch cleaning near water bodies.

Portions of the road system that are in particularly poor condition or are currently closed and in long-term storage will be reconstructed periodically, particularly in connection with land management activities, such as timber harvest projects. Road reconstruction includes application of surface rock, replacing damaged or poorly functioning culverts, adding stream-crossing or ditch relief culverts where necessary, some road widening, and removing roadside vegetation that is encroaching on the road surface and preventing vehicular passage. Again, these activities are expected to create some turbidity increases in nearby water bodies, but BMPs will be employed to minimize erosion and sediment transport to water bodies.

Watershed restoration actions within the Flathead National Forest over the last 20 years have primarily focused on culvert removals, road decommissioning, road relocation, and slump stabilization. The current plan as amended has resulted in decommissioning of over 900 miles of roads primarily to meet Amendment 19 for Grizzly Bear Habitat. Under Alternative A, approximately an additional 518 miles of roads would need to be reclaimed, either on the transportation system as impassable or off the transportation system as decommissioned to meet the Amendment 19 direction. About 57 miles of trails also would no longer allow motorized wheeled use in order to fully meet Amendment 19, unless site-specifically amended. Water resources may benefit from this decommissioning in the long term depending upon the extent of roads near water that are decommissioned. As described in the general effects, there would be some short term impacts to water quality from the sediment delivery anticipated during excavation activities in or adjacent to water bodies.

Decommissioning or storing a road can eliminate long term effects from roads. Approximately 2,131 miles of system road on the Flathead National Forest are closed yearlong, of which 2,098 are ML-1 and no longer receive maintenance, but the impacts of these roads on aquatic resources were not always eliminated. Culverts that are not maintained or are undersized may become blocked with sediment and debris, eliminating its ability to pass water, bedload and debris downstream and increasing the likelihood of road failure and mass wasting. There are approximately 1,500 stream-crossings located on these closed roads with some stream-crossing culverts remaining on the landscape that have not been mapped or inventoried. Similarly, some historic and decommissioned roads have been found to still contain culverts at stream-crossings, but the majority have been removed. The Flathead National Forest had a culvert inventory and monitoring program from 2007 to 2009 and is reinitiating this program in 2016, thus this issue will be further diagnosed under all proposed alternatives. There would be no requirement to reduce stream crossing numbers and the lengths of roads in RMZs within the Conservation Watershed Network (FW-GDL-CWN-01), as required in the action alternatives.

Off trail use is prohibited on the Flathead National Forest and is only allowed on designated routes. The Swan Island Unit near Blacktail has a network of trails for use and the use is located on ridge tops and away from streams so there is little impact to watershed conditions. Cedar Flats and Hungry Horse track are two additional areas that allow motorized use and there are no stream crossings in these areas.

Alternatives B, C, D

The proposed forest wide direction includes direction that would alter road management on the Flathead National Forest to address the detrimental effects of roads on water quality, wetlands, riparian areas, and aquatic species. While INFISH amended forest and road management on the forest, the proposed forest wide plan components found in Alternatives B, C and D would further mitigate road effects on water resources. The Forest identified the desired conditions that roads would not present substantial risks to aquatic resources (FW-DC-IFS-15) and that maintenance along open roads would include BMPs to minimize adverse impacts on water quality (FW-DC-IFS-14). These desired conditions along with those under other resource areas, i.e. watersheds, CWN, RMZs, and soils, are intended to focus future road management to address the impacts of roads on aquatic and riparian habitat and water resources.

Many proposed plan components that affect water quality related to routes and/or road management are the same or modified slightly from current direction, including:

- FW-GDL-IFS-11, which is comparable to INFISH RF-2d, requires the forest to minimize sediment delivery to streams from roads and that road drainage be routed away from potentially unstable channels, fills, and hillslopes. This guideline will reduce the amount of sediment delivered to streams both directly off road and from gullies and mass failures associated with unstable areas adjacent to streams.
- FW-GDL-IFS-14, which is comparable to standard Water 3a under the old forest plan (1986), requires that the transportation infrastructure should maintain natural hydrologic flow paths, e.g. streams should be kept flowing in original channels. This guideline will ensure streams are not routed down ditches and into other stream channels in an effort to maintain current discharge and streamflow patterns and not increase erosion in roadside ditches.
- FW-GDL-IFS-09, which is comparable to INFISH RF-2f, requires minimizing sidecasting into or adjacent to water bodies when blading roads and plowing snow. This guideline is intended to prevent sediment and debris that are mobilized through blading and plowing from reaching streams and affecting water quality (suspended sediment) and fish habitat.
- FW-GDL-IFS-06, which is comparable to standards Water 2c and 2i under the old forest plan (1986), requires that new and relocated roads, trails and other linear features should avoid lands with high mass wasting potential. This standard is intended to reduce road-related mass wasting and sediment delivery to watercourses, and is expected to prevent degradation of water quality at individual sites.

Several plan components are modified slightly from current direction to have increased benefits for water quality and aquatic resources, including:

- FW-STD-IFS-07, which is comparable to INFISH RF-4, requires that new, replacement, and reconstructed stream crossing sites accommodate at least the 100-year flow, including associated bedload and debris. This standard addresses stream crossing structures installed on roads and trails, including bridges and culverts, in order to, at a minimum pass the 100-year flow plus associated bedload and debris, which will reduce the likelihood of blockages and mass failures at stream crossing sites. This standard differs from previous direction in that it applies more broadly to road and trail crossing structures, whereas INFISH RF-4 only required installation of a 100-year crossing structure where “a substantial risk to riparian conditions” exists (p. 12, INFISH, 1995).
- FW-STD-IFS-06 prohibits sidecasting fill material when reconstructing or constructing new road segments within or adjacent to RMZs, which is comparable to the second part of INFISH RF-2f. The proposed FW-STD-IFS-06 standard would apply across the entire forest, whereas the INFISH RF-2f standard only applied to INFISH priority watersheds. This standard is intended to expand benefits to riparian and water resources to a larger geographic extent, thereby reducing the likelihood of road failures and mass wasting into water bodies across the entire forest.

Several plan components are new or expand upon concepts and benefits, such as:

- FW-STD-IFS-04 requires that roads that are to be decommissioned, made impassable, or stored for longer than 1 year would need to be left in a hydrologically stable condition. This standard would apply the concept of leaving a road in a stable condition if it is expected to no longer receive routine maintenance, including roads that are actively/newly stored, closed, or made impassable on the forest. Similarly, FW-STD-IFS-05 requires that travel routes that are to have a physical barrier blocking future access are first assessed for drainage features and treatments must be completed to avoid future risks to aquatic resources. In effect, this standard will require the forest to assess and treat drainage features on roads, skid trails, temporary roads, and trails prior to blocking off vehicular traffic to ensure the road is left in a hydrologically stable condition. The combination of these two standards will improve water quality downstream and adjacent to roads as a result of reducing the likelihood of sediment delivery from road failures where unmaintained culverts have become blocked and have failed.

- FW-GDL-IFS-03 requires that the water drainage systems on roads, skid trails, temporary roads and trails should be hydrologically disconnected from surface water bodies to prevent the delivery of sediment and pollutants and maintain the hydrologic integrity of watersheds. This guideline is a critical element to reduce non-point source pollution from forest roads and trails and is expected to have the greatest impact to maintain current water quality, prevent increased peak flows and water elevation in water bodies, and maintain current hydrologic regimes across the forest. Under this guideline, water that is collected on hardened surfaces or in road ditches will be routed to the forest floor and allowed to infiltrate subsurface water systems in stable areas.
- FW-GDL-IFS-07 requires that new or redesigned stream crossing sites should be designed to prevent diversion of streamflow out of the channels in the event that the crossing becomes plugged or experiences more water than the crossing was designed to handle. Under this guideline, effort would be taken when designing and installing stream-crossing structures to route high flows directly over the top of the road at that site to prevent water from running down the ditch or road surface, which can exacerbate more road failures and sediment delivery to streams. This guideline could be considered similar to INFISH RF-2e, which requires each existing or planned road to avoid disrupting natural hydrologic flow paths.
- FW-GDL-CWN-01 requires that subwatersheds included in the CWN allow no net increases in stream crossings or road lengths within RMZs unless the net increase improves ecological function in aquatic ecosystems, e.g. moving a road out of a floodplain and up onto a hillside may warrant a longer road length but is expected to provide greater benefits to the stream and floodplain. This net increase is to be measured from beginning to end of each project. The no net increase of road lengths within RMZs is also expected to reduce the impacts of roads on water quality, as there would be less likelihood for road failures and mass wasting in the RMZ that could deliver sediment to streams.
- FW-GDL-RMZ-03 requires that new road construction, including temporary roads, be generally avoided in RMZs except where necessary to cross streams. This guideline is consistent with and similar to the requirements of Montana's SMZ law, which only allows road construction within the SMZ to cross streams, but the RMZs under the proposed plan are larger in size than the state-mandated SMZs. This guideline is expected to maintain water quality by reducing the likelihood for road failures and mass wasting in the RMZ that could deliver sediment to streams.
- FW-STD-SOIL-03 and 04 require that soil function be restored when temporary roads are no longer needed and existing roads are decommissioned. The exact treatments necessary at any site would be determined based on site-specific characteristics, but in many cases, these standards would result in these road surfaces being decompacted and available slash would be applied. If the road has already revegetated and is found to already be in a hydrologically stable condition, these roads may not receive further treatment so as not to prevent disruption of the natural restoration process that has begun. But in the case when roads are decompacted and covered in slash, rainfall and water drainage is expected to infiltrate into the ground and no longer be delivered to water bodies, which will reduce the likelihood of concentrating flow and improve water quality.

Relative to the existing road network, the effects of proposed road construction under the various alternatives are minimal, because having no net increase in the Primary Conservation Area for grizzly bears limits the extent of the transportation system. Maintenance, reconstruction and decommissioning all address the existing forest transportation system and are expected to influence aquatic resources more than road construction over the planning period.

Due to the programmatic nature of the DEIS it is difficult to determine the effects of alternatives with respect to the use of roads during timber harvest. For example, alternative D removes the most timber volume, but alternative C treats the most acres. The effect on log hauling on aquatic resources is dependent upon a number of variables, such as: road surface, miles to access harvest units, proximity of a road to a stream, the amount of volume on a log truck, etc. These types of impacts are evaluated on a project-specific basis. Plan direction relative to roads is expected to minimize effects on aquatic resources.

The removal of stream-crossing culverts and reestablishment of a natural stream grade is expected to have the greatest impact on water quality in the action alternatives. As mentioned previously, Cook and Dresser (2004) found that stream-crossings that were restored through decommissioning delivered only 3 to 5 percent of the amount of fill material that was originally located in the road prism at the stream-crossing location. Alternatives B, C, and D would restore stream crossings across the forest and particularly in the CWN, which would decrease the amount of sediment delivery to streams that would result from potential road failures. These reductions will also result due to the application of Best Management Practices that prevent gully formation and downcutting through newly excavated stream channels, such as establishing a stream bed that mimics the natural stream gradient above and below the crossing, placing cobble-size rock in newly excavated streambeds, and distributing any uprooted vegetation and slash across stream-adjacent disturbed areas. Overall, all action alternatives are expected to provide a decrease in stream turbidity in forest water bodies and streams, as well as an improvement of bedload size distribution and channel morphology over the long term.

Effects on water quality from lands and special uses

Background

The forest issues a variety of permits for projects under the lands and special uses programs. Forest Service permits can lead to interrelated and interdependent effects on private lands that are enabled by issuing a road use permit or right-of-way grant.

Management activities that result in ground disturbance near streams/water have the potential to affect water quality. These potential increases are based on site-specific factors such as slope, soil types, proximity to water bodies, residual ground cover, revegetation, etc. Conversely, soil erosion, loss of long-term soil productivity, stream sediment, and turbidity can increase due to increased road activity from issuance of road use permits or granting of right-of-ways. Road-related effects are discussed above.

Alternatives A, B, C, D

Land and special uses guidelines (FW-GDL-LSU) would mitigate these types of general effects for the action alternatives. The guidelines are similar for each alternative as they were modified from alternative A which adopted the INFISH guidelines in 1995 under amendment to the 1986 plan. Permitted power and telephone line construction and maintenance would continue under all alternatives. Maintenance of utility lines usually require vegetation to be cleared 10 to 50 feet from the power line either side of the right of way. Clearing brush and trees in riparian areas may increase solar radiation to streams and the forest floor, increasing water temperature. The limbing, topping, or removal of hazard trees near utility lines can also reduce in-channel wood. Plan components FW-GDL-LSU 02 would minimize the effects by re-establishing or mitigating habitat conditions. The very nature of power and telephone lines will result in riparian vegetation to be reduced where they cross and/or adjacent to the stream network. The permitting process will look at options to minimize this effect.

Implementation of standards and guidelines FW-GDL-LSU 02-04, watershed conservation practices, and state BMPs mitigate these impacts at the project level by relocating existing facilities within RMZs if required but may not completely eliminate them. However, it is assumed that temporary and short-term impacts would still occur where special uses are allowed or mandated. Actions may also occur where the risk of short-term effects is worth taking because there would be significant benefits to watershed resource conditions over the long term. Existing facilities and actions within or affecting RMZs may need to be modified, discontinued, or relocated if they are not maintaining or improving fully functional aquatic/riparian conditions and processes. Modification or relocation of facilities may cause temporary affects. Where facilities cannot be located outside of RMZs, effects would be minimized to the greatest extent possible, but not completely eliminated.

Effects on water quality from restoration projects

Background

A wide variety of watershed restoration activities may occur throughout the life of this plan. These activities include instream restoration projects, including the installation of large woody debris, riparian planting, fish barrier installations, and road restoration projects, including road relocation projects, road decommissioning, and fish passage projects. The effects of road restoration projects on water resources are not discussed here and instead can be found in the section regarding the effects on water quality from roads.

Aggrading substrate behind placed stream-structures can reduce the low-flow wetted channel width and the width-to-depth ratio, increase sinuosity and meander pattern, and over time restore floodplain connectivity. Structures can stabilize stream channels over the long term and make them more resistant to erosion by dissipating stream energy during periods of high runoff. Gravel bars typically re-vegetate with riparian species such as alder or willow, ultimately leading to channel narrowing and stabilization. Restoration of floodplain connectivity over time will result in more frequent inundation of the floodplain, fostering the creation of side channels, seasonally flooded potholes, and other kinds of off-channel habitats.

Placement of large wood can improve sediment routing while creating more physically complex fish habitat. The stability or longevity of this wood within streams is strongly linked to its size, orientation to flow, channel dimensions, watershed area above the structure, and the percentage of the log that is in the active channel. Eventually some movement downstream will take place. Pieces that move can become incorporated in larger wood complexes or hang up on streamside trees or other channel features.

Alternative A

INFISH amended the 1986 plan to include four guidelines for restoration. Restoration actions since that time have primarily focused on culvert removals, road decommissioning, road relocation and slump stabilization. These activities result in short term sediment impacts to streams but ultimately result in long term watershed benefits.

Alternatives B, C, D

Restoration effects can be of a long term positive effect but be of a short negative nature; typically short term effects occur during implementation by increasing sediment, however, long term sediment reductions are accrued. Standards and guidelines would mitigate the general negative effects described above under all alternatives. Alternative C would have the most recommended wilderness and potentially the fewest impacts and thus the lowest need for restoration activities. Alternative D would potentially have the greatest impact due to timber harvest, however, the standards and guidelines would limit road construction and thus restoration associated with new actions most likely would not be needed. Alternative D would have the most active forest management and would generate more money that funds stewardship projects. Stewardship funding is currently a tool often used for restoration projects as well as appropriated dollars for watershed and fisheries. If more money is available from Alternative D then there would be more short term impacts from restoration projects but there would be more long term gains. The highest priority for these restoration actions would be within the Conservation Watershed Network to benefit native fish. It is expected that temporary and short-term impacts to fish, stream channels, water quality, etc. from culvert removals, in-channel restoration, and habitat surveys will still occur. It is also expected that long-term positive effects would occur from these restoration activities.

Effects on water quality and quantity from timber and vegetation management

Background

Managing vegetation on forest lands can impair water quality by routing runoff and sediment onto bottomland stream areas. Over the last planning period, management addressed these impacts by regulating the extent of upland timber harvest, applied best management practices to limit connection from impervious surfaces, and minimized entries into Riparian Habitat Conservation Areas (RHCAs) to provide protection from upslope activities and filter runoff. The use of these best management practices were instituted in the 1980s to control non-point source pollution (Binkley and Brown 1993), while the RHCAs were established with the INFISH amendment to in 1995. Using results from the State of Montana audits of BMPs, the Forest Service BMPs were effective 96 percent of the time (Zisak 2015). Using a similar audit scheme, the Forest Service was 100 percent effective in establishing the correct buffer to meet the State of Montana design standards for streamside management zones (SMZs).

Forest management disturbs uplands through removal of tree canopy and the yarding of the material to a central processing facility. Site preparation historically reduced groundcover by broadcast burning remaining vegetation to bare soil for planting and clear remaining fuels. The practice in the 1980s produced higher severity fire because of the purposeful clearing of this vegetation also removed protective groundcover. The Flathead NF has largely moved away from this practice with either mechanical piling/burning or prescribed fire as primary methods for reducing hazardous fuels. A change in contemporary timber practices to whole tree yarding has further reduced remaining vegetation while preserving protective groundcover covering at least 85% of the area based on soil monitoring data (Milner 2015).

Studies have documented increased sediment erosion associated with timber harvest, but the primary agent is sediment from roads (Bilby et al. 1989, Luce and Black 1999, Sugden and Woods 2007). Management controls non-point delivery of sediment within harvest areas through the use of water and soil conservation practices and best management practices (USDA 1987, USDA 2012), oriented on the stabilization of log skidding and landing networks where erosion is most probable. Otherwise, forests generally have very low erosion rates with chronic erosion after disturbance lasting typically one to three years (Elliot et al. 2000). After timber harvest and site preparation, regrowth of vegetation covers the soil surface with plant litter, soils armor, and potential erosion hazard becomes low (Ibid).

Where prescribed fire is applied and blackens the area, the runoff can increase from reduced infiltration. Blackened soil areas can accelerate runoff due to soil sealing from ash that lowers the infiltration capacity of soils (Larson et al. 2009, Doerr et al. 2006). These conditions vary spatially and decrease over the first year as products of burning in the soil degrade (Wonzell and King 2003, Doer et al. 2006). Natural forest conditions have hydrophobic conditions that resist infiltration when soils dry and from plant litter waxes, but the main difference is that burned areas burned areas lack surface roughness to dissipate rain splash energy and interrupt runoff. Other factors that increase runoff from harvest and burn areas are steep slopes, low groundcover, and long slope lengths (Elliott 2013). Runoff transports loose soil particles and deposits sediment down the slope proportional to runoff energy. One reason sedimentation decreases over time is that the sediment supply decreases after bare surfaces armor, lacking a ready sediment supply. Over the past planning period, management has mitigated prescribed fire by not lighting fire within stream buffer areas and burning during cool and moist conditions that results in low and moderate severity fire (see Soils section).

The loss of forest canopy on harvest sites changes the water balance, and studies in the Pacific Northwest have documented cases where excess water from harvest areas influence peak and timing of stream flows (Moore and Wandzell, 2005; Keppeler and Ziemer; 1990; Stednick, 1996). In reviews, these cases depended largely on the extent of harvest and climatic regime (Grant et al. 2008). The effect diminishes in time as vegetation re-establishes. Peak flow increases were raised as a concern from the potential to alter stream morphology and degrade water quality. The altering of streamflow can also influence stream temperature (Swanston 1991), although the principle factor in affecting stream temperature is changes to riparian cover that shades streams (Beschta et al. 1987, Macdonald et al. 2003, Gomi et al. 2006).

Watershed yield studies specifically targeted timber harvest activities that would generate a response and may not necessarily mimic current forest practices. Bescheta et al. (2000) found a weak relationship between forest harvest and increased peak flows, and reported “mixed messages” about the relationship between forest harvest and peak flow responses. Numerous studies documented the effects of forest canopy removal on peak flows in the Pacific Northwest (Kuras et al. 2012, Tonina et al 2008, Hubbart et al. 2007, Beschta et al. 2000, Thomas and Megahan 1998, Jones and Grant 1996,), but surprisingly, very few demonstrated a direct link between water yield/peak flow changes and measured channel impacts in forested environments. In the latest review for Pacific Northwest studies, Grant et al. (2008) suggested that if degradation were to occur, channels most sensitive to peak flow changes are low gradient with gravel bed and sand bed substrates.

Forest service analysis techniques rely on relationships between canopy cover area and generalized recovery trends to evaluate risk for harvest. One of these approaches uses equivalent clearcut acres to equilibrate area harvested to runoff potential (Ager and Clifton 2005) to evaluate potential effects on streams. However, a direct relationship between ECA metrics and channel conditions proves difficult. Schnakenberg and MacDonald (1998) found no correlation between ECA and stream channel characteristics in forested catchments in Colorado. MacDonald et al. (1995) studied the relationship between WATSED-predicted water yield/peak flow increases and channel characteristics on the Kootenai National Forest. WATSED similarly equilibrates the area harvested to potential sediment. None of the channel types (pool riffle or colluvial step-pool) showed any increase in bankfull width or width/depth ratio with more intensive management. In addition, there was no apparent correlation between the amount of timber harvest and the magnitude of peak flows, and climatic differences are the dominate control on the size of peak flows in the study area (MacDonald et al. 1995). These studies highlight the difficulty in associating size of harvest to effects at a reference scale of a watershed.

The concern over changes to peak flow from timber harvest was raised when timber was harvested on a larger scale than current. The Flathead NF no longer harvests timber at a rate seen in the 1970's. Average annual harvest rates were 11,000 acres in the 1980's compared to roughly 2,000 acres currently. In addition, many of the classic watershed studies could not disentangle the effects from roads where at least 2 percent of the study areas had roads and skidding network (Grant et al. 2008). Forest management has somewhat alleviated these effects by establishing streamside buffer zones (RHCAs with INFISH), reducing road construction and implementing BMPs. Plan components limit further road construction within the Primary Conservation Area for grizzly bears and within the Conservation Watershed Network that applies to 87 watersheds out of a total of 220 watersheds.

Alternatives A, B, C, and D

The section below focuses on the effects of the action alternatives in respect to harvest of forest canopy and skidding systems, fuels and prescribed fire. Effects from roads are treated separately due to their higher risk for affecting water quality and quantity. Water quality effects attributed to timber harvest could include increased sediment, nutrient load, and temperature.

The action alternatives would not increase risk for impairing water quality over the current direction. For uplands, the new plan would continue using BMPs to reduce offsite transport of sediment to streams from either timber harvest area or prescribed burn slopes. Standard FW-STD-WTR-02 re-enforces this commitment. Additional improvements in water quality may offset past impacts with the FW-OBJ-WTR-01 and 04 that directs restoration activities to priority watersheds. The effectiveness of BMPs for avoiding sediment was reviewed in a contemporary study in California. Out of 220 units examined, sixteen instances were found where skid trails delivered sediment to streams (Litschert and MacDonald 2009). The authors concluded that in most cases the BMPs were effective. Surface roughness on skid trails was one of the factors that was found to alleviate overland flow and sediment delivery. The Flathead NF uses slash in addition to waterbars to stem overland flow and reduce sediment delivery. Also, the belt rock geology of the Flathead NF would have less potential for producing sediment than the granitics in the Litschert and MacDonald (2009) study area based on findings from Sugden and Woods (2007).

The harvest table in the Timber section 3.20 displays projected annual harvest rates (acres harvest per year) constrained by budget, distinguishing by intermediate and even-aged regeneration harvest. The projections were based on outputs from the spectrum model (see Vegetation Section). Annual average harvest rates over the next two decades are: Alternative A at 1,140 acres, Alternative B at 2,824 acres, Alternative C at 2,908 acres and Alternative D at 2,121 acres. Of these, Alternatives B and C plan to use intermediate harvest (thinning) at 930 and 2,664 acres per year respectively. Alternative B and D have similar rates of regeneration harvest although runoff risks may be more pronounced in Alternative D due to planned higher intensity harvest.

The effects from these alternatives were compared using regeneration acres since regeneration harvest clears more forest canopy and has higher machine trafficking than intermediate harvest (see Timber section). These differences may be small since the skid trail network does not vary between regeneration harvest and intermediate harvest and forest canopy is a poor correlate for impacts to streams. Alternative C would have the least risk for connecting harvest area runoff and sedimentation to streams by using the least amount of regeneration cutting. Alternatives A, B and D would have very similar risk based on similar regeneration harvest treatment acres.

The action alternatives would carry on similar protections using BMPs to stabilize skid trails and landings and disconnect these from road ditch and stream networks drawing from Region 1 Soil and Water Conservation Practices (USDA 1987). The effect would reduce risk for runoff and sediment. Protections were strengthened in the new plan by excluding designated skid trails and landing constructions in riparian management zones (FW-GDL-RMZ 2). Alternative A minimizes construction of these features in riparian areas.

The difference in these alternatives may also be subtle since management controls the extent of harvest within drainages. Risk may be somewhat arbitrary since management controls harvest extent across the watershed and below a threshold of concern. Instead of harvesting whole watersheds, management scatters harvest. Also, recent studies showing the water yield changes from beetle epidemic have brought out the complex relationships between forest canopy and water yield in snow dominated regimes - et al. 2015). Though decreases in forest cover can increase snowpack and available moisture, the lack of shading can accelerate snowpack runoff (Varhola et al. 2010). Shading can offset snowmelt losses where the forest canopy remains. Furthermore, Grant et al. (2008) in a review of water yield studies showed that fall soil deficits between cut and uncut stands explained water yield differences; cut stands lacked the transpiration and thus were prone to generate greater yield since soils had more available water and thus were less prone to infiltrating fall storm moisture. For the Flathead NF, soils rarely have saturated soil conditions during fall and thus these differences would be subtle.

Effects from timber harvest on nutrient loads in streams would not vary measurably across alternatives. The use of RHCAs and now RMZs has substantially reduced increased nutrient loading from adjacent harvest areas. The reasoning is based on current actions, Alternative A, not showing a strong connection of upland vegetation treatments producing nutrient loads beyond state standards. Though not comprehensive across the forest, two streams in the heavily managed watersheds of Fish and Sheppard Creeks were recently delisted from prior impairments for phosphorus and nitrate/nitrite nutrient load. In 2014, Montana Department of Environmental Quality reassessed Fish and Sheppard creeks. The assessment was performed according to the DEQ nutrients assessment methods, to update the 2014 303(d) List of impaired waterbodies. The assessment concluded that Aquatic Life uses are not impaired by nutrients. Total Phosphorus and Nitrate/Nitrite were delisted as causes of impairment affecting Aquatic Life/Fishes (MDEQ 2014). Goat Creek remains listed for Total Suspended Sediments from silvicultural practices and roads/bridges.

Timber harvest was attributed to nutrient loading by changing water temperature, hydrologic regimes, flow pathways, primary production, and organic matter content of soils (Gravelle et al. 2009). However, because of the natural variability in geology, climate, atmospheric inputs, and vegetation, as well as the wide range of forest management practices that can be applied, the measured effects of timber harvest are highly variable. The effect also depends on the ability for runoff either from roadwash or indirectly through shallow throughflow in soil which can deliver water. The greatest changes to nutrients comes from burning by pile or across the harvest area and prescribed burn. The burning decomposes plant material leaving high rates of ammonium and nitrate; nitrate remains highly mobile in soil. This is a natural process and part of beneficial results from fire. In the aftermath of watershed wide wildfire, the ammonium and nitrate can concentrate to levels toxic to fish.

The impacts from prescribed burning would be minor since burning results in low and moderate severity that has low potential for delivering sediment. The effects of prescribed burning were identified as generally insignificant with regard to a wide range of hydrologic and water quality variables (USDA Forest Service 2000). Prescribed burning extent would follow that of timber harvest since most burning from forest wide perspective follows harvest activities. Alternative A would likely have the least amount of burning compared to all the action alternatives with the lowest projected average annual harvest treatment acres across the two decades.

Another potential source for nutrients is phosphorus bonded to sediment (Ballantine et al. 2008, Grant et al. 1996, and Woods et al. 2005). Detachment of soil particles and associated phosphorus (P) is often linked to soil erosion, which provides a physical mechanism for mobilizing P from soil into waters (Wood et al. 2005). The greatest input of sediment remains from roads. Few studies have found statistically significant increases in phosphorus concentrations associated with clearcuts. Using table 2, Alternative C would have the least potential for offsite erosion and delivery to nearby streams of sediment with bonded phosphorus.

Temperature would likely not vary according to alternatives from management actions. The established RHCAs have preserved streamside vegetation that shades streams. The Flathead NF does not clear forest within RHCAs and future RMZ would also not clear forest canopy along streams.

Effects on water quality from wildfire and burning for resource benefit

Background

Fire effects vary according to fire intensity, severity, and frequency, the primary factors that define fire regimes. Wildfires can affect water chemistry, water quantity, and stream channel structure through changes in transpiration, infiltration, ground water recharge, erosion and mass wasting, riparian shading, and the recruitment and delivery of coarse debris (Moody and Martin 2001a and 2001b, Moody 2001, Wondzell 2001, Gresswell 1999, Benda and Dunne 1997). Potential post-wildfire risks from floods, landslides, and debris flows to human life, property, and/or municipal supply watersheds are an increasing concern across the western United States (Moody and Martin 2001b).

Climatic events following wildfire can trigger surface erosion or mass failures (landslides), which in turn can deposit sediment that alters stream channel structure and function. Severe wildfire can result in large expanses of blackened area that has high hazard for generating runoff and delivering sediment to streams when intense rainstorms occur. When wildfire burns through riparian area, the outcome may leave riparian areas with no shade that increases water temperatures. This effect may be offset by cooler groundwater from adjoining slopes.

Alternatives A, B, C, and D

Wildfire suppression tactics can affect watershed resources by building fire line and large fuel-breaks, using fire retardant, causing soil disturbance, and removing vegetation. Ground-disturbance from wildfire suppression, in addition to bared ground by wildfire can cause a net decrease in effective ground cover that no longer resists rainfall runoff. These activities can route sediment to streams from compacted machine paths and linear features that channels runoff. Rehabilitation after fire tries to mitigate these effects across the fire area. The action alternatives would mitigate these effects by limiting fire suppression activities away from the most sensitive areas, RMZs. The action alternatives carry forward forest plan components to locate fire camps away from riparian areas where risk of sedimentation and degradation to water quality highest (FW-GDL-RMZ 5). The action alternatives would have stronger language to avoid degrading water quality from suppression activities by minimizing suppression activities in RMZ (FW-GDL-RMZ 8), with specific direction to avoid building line in RMZ that could drain runoff into streams (FW-GDL-RMZ 6).

Impacts to RMZs and habitat may still occur in certain circumstances when no other suitable locations for incident bases, camps, heli-bases, staging areas, etc., exists. Delivery of chemical retardant, foam, and other additives near or on surface waters may occur when there is imminent threat to human safety and structures or when a fire may escape causing more degradation to RMZs, than would be caused by addition of chemical, foam or additive delivery to surface waters in RMZs. Conversely, where management treatments are used to reduce wildfire hazard, positive long-term effects may be realized.

Other fire suppression effects to water quality occur from fire retardant drops. Large quantities of retardant can kill fish, while indirectly fire retardant can kill stream invertebrates and cause eutrophication of downstream reaches (Spence et al. 1996). The action alternatives would improve direction for fire retardant drops. Rather than relying solely on resource advisors to avoid risks as in alternative A, areas of high risk would be mapped to improve the communication of where aerial operations need to avoid dropping fire retardant (FW-GDL-RMZ 4).

Effects of wildfire on stream runoff, sedimentation and nutrients are largely beyond the forest planning scope because we cannot predict when and where wildfires will burn. However, monitoring of these effects has shown mostly temporary, transient effects of wildfire on water quality. Monitoring by Fish Wildlife and Parks of percent fines in the North Fork in Trail, Whale, Coal and Big creeks following the Moose Fire (2001) and Robert Wedge Fire (2003) showed only small increases in sediment in the year following the fires with a return to base levels within several years.

All action alternatives would increase the area wildfires can burn for resource benefit when compared to current direction (see Fire and Fuels section). Managing fire for resource benefit could increase incidents of sediment deposits, but would promote ecological processes by allowing low and moderate severity fire at a more natural rate. Potentially Alternative C would have the highest amount of acres burned for resource benefit because Alternative C has the least amount of acres for active forest management. We assume active management can affect fire behavior and that Alternative C would rely on more wildfire to meet desired changes in vegetation.

Effects on *water quality from noxious weed treatments*

Background

Noxious weeds are often treated using an integrated approach, with a combination of control methods that include mechanical, biological, and chemical. The effects of some of these methods are discussed here.

Effects from herbicide application depend on the type, extent, and amount of herbicide that is used, the sites' proximity to a stream or wetland, a stream's ratio of surface area to volume, and whether transport from the site is runoff or infiltration controlled. Chemical persistence in the soil profile and surface water depends on the potential for the chemical to leach through groundwater, the size of the treatment area, velocity of streamflow, and hydrologic characteristics of the stream.

Direct effects require that an organism and the chemical come in contact. Once in contact, the chemical must be taken up by the organism in an active form at a concentration high enough to cause a biological effect. Most direct effects of herbicides on trout are likely to be sub lethal, rather than outright mortality. However, sub lethal effects of chemicals and pesticides can play a significant role in reducing the fitness of natural salmonid populations. Scholz et al (2000), and Moore and Waring (1996) indicate that environmentally relevant exposures to diazinon can disrupt olfactory capacity needed for survival and reproductive success, both of which are key management considerations under the ESA (Scholz et al. 2000). The ecological significance of sub lethal effects depends on the degree to which they influence behavior that is essential to the viability and genetic integrity of wild populations.

Indirect effects can include decreases in terrestrial or aquatic insects that result in a decrease in the food supply for fish, and reductions in cover and shade from riparian resources. It is assumed that many chemicals used will be benign. For example, glyphosate without surfactants (e.g., Rodeo®, Accord®) has little effect on fish. Some chemicals like picloram, which is highly soluble and readily leaches through the soil, may not be benign.

Mechanical treatments can result in localized soil disturbance as plants are pulled. Increased sediment to streams along road cuts and fills within riparian areas is possible, but the increase would likely be undetectable due to several factors. First, not all vegetation in a treated area would be pulled, so some ground cover would still be in place. Second, not all sediment from pulling weeds along roads would reach a stream because many relief culverts divert ditch flow onto the forest floor away from streams. Finally, hand pulling is very labor intensive and costly. Thus only a few acres per year could be treated using this technique across a watershed.

Alternatives A, B, C, D

Although many threats to water quality from chemical application may be reduced, they cannot be eliminated. This is in part due to the uncertainty surrounding sub-lethal effects to salmonids and other aquatic organisms. As discussed above, there are gaps in the scientific knowledge of how pesticides interact with the biology of trout. Effects to trout may occur that are not readily apparent and effects would be consistent across all alternatives as management or plan direction does not differ between alternatives. Guideline (FW-GDL-NNIP-01) would apply to RMZs to minimize effects to water quality by using alternatives to chemicals for treatments within RMZs thus reducing leaching or drift from chemicals into the water.

Effects on water quality from wildlife management

Alternative A

The Flathead National Forest plan was amended in 1995 by INFISH, which will continue to provide standard and guidelines to limit management actions that may impact aquatic species. Amendment 19 amended the plan in 1995 for grizzly bear security areas and reduced road densities. Under the no action alternative, the forest would continue to strive towards meeting Amendment 19 standards to reduce road densities. Benefits for fish would be derived by reducing road densities although there would be short term impacts related to sediment increases.

Alternatives B, C, D

Alternatives B, C and D propose several standard and guidelines to benefit grizzly bears that will be beneficial to aquatic species because they limit the amount of road construction, grazing, recreational development or mining surface occupancy that may adversely impact aquatic species. The greatest benefits will be derived for aquatic species in the PCA, followed by the DCA and Zone1 respectively. The following are a synopsis of beneficial standards or guidelines (there are no standard and guidelines designed for grizzly bears that provide adverse effects to fish):

- **NCDE-STD-AR-01-** this standard will limit the amount of vehicle traffic in the PCA which will for some vegetation to become established on the road surface and limit sediment production. Gated roads also benefit native fish by making fishing access more remote.

- **NCDE-STD-AR-02-** This standard will limit road construction in the PCA which will reduce sediment production.
- **NCDE-STD-AR-05-** This will limit the number of recreation sites in the PCA which if they are proposed near streams will provide benefits in the long term since there can be no more than 1 in a BMU.
- **NCDE-GDL-AR-02**- Restoring temporary roads in the PCA within one year will reduce potential sediment inputs following management activities.
- **NCDE-STD-GRZ-02-** Capping AUMs in the PCA and DCA/Zone 1 under Alt. 3 may reduce impacts to aquatic species depending on the location of the allotment.
- **NCDE-STD-GRZ-05-** Capping the number of cattle allotments in the PCA and DCA/Zone 1 under Alt. 3 may reduce impacts to aquatic species depending on the location of the allotment.
- **NCDE-GDL-GRZ-02-** Protecting riparian areas for grizzly bears will also provide protection for aquatic species and habitat.
- **NCDE-STD-MIN-05-** Measures provide for RMZ restoration and maintenance for operating plans.
- **NCDE-STD-MIN-08**. Within the NCDE Primary Conservation Area and Zone 1(including the Salish Demographic Connectivity Areas), new oil and gas leases shall include a no surface occupancy stipulation under Alt. 3 which will benefit aquatic species by limiting surface disturbance depending on the location of the proposal.

3.2.9 Riparian environmental consequences

Effects of forestwide direction on riparian areas

Background

Riparian management zones (RMZs) are portions of watersheds where riparian-associated resources receive primary emphasis, and management activities are subject to specific standards and guidelines. RMZs include traditional riparian corridors, wetlands, intermittent streams, and other areas that help maintain the integrity of aquatic ecosystems by 1) influencing the delivery of coarse sediment, organic matter, and woody debris to streams, 2) providing root strength for channel stability, 3) shading the stream, and 4) protecting water quality (Naiman et al. 1992). RMZs provide other riparian functions, including delivery of organic matter and woody debris, stream shading, and bank stability. Another critical function of RMZs is to provide for wildlife habitat use and connectivity.

The Inland Native Fish Strategy (INFISH) remains as amended to the Flathead Forest Plan in 1995 for Alternative A. INFISH reduced the risk to watersheds, riparian and aquatic resources by improving riparian zone protections. Riparian Habitat Conservation Areas (RHCAs) established management zones along riparian areas from 50 to 300 feet depending on streams having fish, annual flow regime, and wetland size. PIBO monitoring showed an improvement in stream conditions since 1995, implying RHCAs were effective at protecting stream habitat.

Alternative A

The Inland Native Fish Strategy (INFISH)(USDA 1995), as it was amended to the Flathead Forest Plan in 1995, is unchanged from its original wording in Alternative A. INFISH reduced the risk to watersheds, riparian and aquatic resources by improving riparian zone protections. Riparian Habitat

Conservation Areas (RHCAs) established management zones along riparian areas from 300' for fish bearing streams on both sides of the stream on down to 50' on both sides for intermittent streams. In addition, RHCAs were also established for other waterbodies such as wetlands, lakes, etc. based upon size greater or less than 1 acre. Riparian Habitat Conservation Areas established management zones along wetlands for 150' in wetlands greater than 1 acre and 50' in wetlands less than 1 acre. Monitoring has shown an improvement in stream conditions since 1995 as RHCAs have been effective at protecting stream habitat. Under Alternative A, these protections would stay in place and riparian habitats as well as associated uplands would continue to be protected.

Alternatives B, C, D

The action alternatives would rename and redefine riparian widths, replacing RHCAs with RMZs. The RMZs would give flexibility to improve vegetation condition with contingencies on inner versus outer portions of riparian areas; areas closer to streams have greater management limitations. The Flathead NF would establish three qualitative desired conditions instead of using INFISH defined resource management objectives. These desired conditions describe composition and structure, species assemblage and functional variables for riparian habitat (FW-DC-RMZ-01, 02, 03). The Flathead NF would rely on PIBO monitoring and collaborative monitoring with USFWS and MFWF to ensure riparian conditions meet desired conditions rather than using the six indicators originally defined in INFISH.

The effects of the RMZs could advance riparian condition by moving from a protective to active conservation strategy. Management of the inner RMZs would remain expressly for the purposes to conserve riparian, fish and aquatic resources, while the outer RMZ would allow for other management objectives. The new direction could allow the Flathead NF to promote hardwood species. The current distribution of riparian hardwoods falls within expected ranges (see Vegetation section), however, this distribution can be affected by major events of fire and floods. Examples of active management within the inner RMZ to improve conditions would be non-commercial thinning to stimulate large tree growth and expand growth of hardwood tree species. In contrast, INFISH would not allow non-commercial thinning within the riparian area.

The RMZs would expand the management of riparian area from 327,787 acres under INFISH to 427,320 acres on NFS lands. This change would shift management within RMZs depending on inner and outer portions; the inner portion of the RMZ would be managed expressly for riparian conservation values, while the outer portion RMZ could allow for riparian condition and other management purposes. Management direction for RMZs has 6 standards and 10 guidelines. FW-STD-RMZ-01 would establish the same riparian widths as INFISH for perennial fish bearing and perennial non-fish bearing. The riparian width would be firmed at 100 feet for all intermittent streams instead of varying from 50 to 100 feet under INFISH. All mapped wetlands, regardless of size, would be buffered with a 300 foot RMZ instead of INFISH's maximum 100 foot buffer. The Flathead NF has a recent wetland mapping updated in 2014 by Montana Natural Heritage Program so protections would be more expansive than in the past. Protections to RMZs would be assured with the following management limitations: consistency with state law (FW-STD-RMZ-02), a constraint on management within the inner portion only when necessary to maintain, enhance or restore riparian condition (FW-STD-RMZ-03), and a limitation that management not degrade long term condition of the RMZ outer portion.

The inner boundary would be established during project planning based on slope characteristics. FW-STD-RMZ-01 defines inner width as either half the RMZ width or the distance to the top of inner gorge features depending on which is larger. Inner gorges occur when streams incise within the hillslope creating steep erosion prone sideslopes. The top of the inner gorge represents the break in slope to shallow gradient hillslopes. The specific reference to inner gorge was carried forward from INFISH.

The allowance for multiple management purposes would not degrade the RMZ over the long term (FW-STD-RMZ-02). The flexibility of management purpose comes with contingencies to control negative effects from timber harvest operations that can degrade riparian condition. FW-GDL-RMZ-02 directs to exclude new landings, designated skid trails, staging and decking in RMZs unless no other alternative. New road and temporary road construction would be prohibited within RMZs except where needed to cross streams (FW-GDL-RMZ-03). Refueling would also be avoided within RMZs (FW-GDL-RMZ-07). Finally, tree canopy would be retained by excluding clearcutting in RMZs (FW-GDL-RMZ-10).

Though not expressly prohibited, INFISH direction made management difficult with riparian areas despite intent to create desired vegetation conditions. The difficulty in meeting numerical riparian management objectives in effect established the INFISH buffers as management exclusion areas. Thus, active management to improve condition was difficult to implement. These buffer areas also created concern for fire hazard since the abundant growth indicative of riparian areas advances latter fuels thickness and incidence for crown fire.

Managing RMZs could in some places advance riparian condition while preserving the functional attributes for riparian and aquatic resources and water quality. Monitoring and research reports over the past 20 years have documented the efficacy of buffers. Using stream temperature as a response variable, a study in Oregon found no differences before and after project using a no-cut buffer as small as 25 feet (Groom et al. 2011). Similarly, a comprehensive study in Oregon and Washington that evaluated various buffer widths found no increases in stream temperature using a 50 feet buffer (Andersen and Poage 2014). The study did point out that the efficacy depended on the adjacent disturbance and contrast in forest canopy. The RMZs would not allow regeneration timber harvest within the outer portion to moderate effects of forest canopy alteration.

The following additional protections on RMZs would largely not lead to different outcomes from current INFISH direction in Alternative A. To limit impacts from fire suppression activities, RMZs would have limited exposure to fire retardant (FW-GDL-RMZ-04) and only allow location of temporary fire facilities in rare circumstances (FW-GDL-RMZ-05). These protections carry forward existing protections in Alternative A. New direction strengthens protection against adverse impacts from fire suppression activities to riparian areas. Fire line construction and use of heavy machinery would be conducted to minimize impacts to riparian areas (FW-GDL-RMZ-06, FW-GDL-RMZ-08). For sand and gravel mining, the RMZs would carry forward existing direction with the exception of disturbance for trail work (FW-GDL-RMZ-10).

Effects of additional recommended wilderness on riparian

The current forest plan as amended proposes 98,400 acres of recommended wilderness. The areas that are recommended for wilderness are high elevation and will protect headwater habitats that will provide cold clean water downstream to fish and habitat. Alternative A will continue to provide long term protections to riparian areas in recommended wilderness areas but not as much as alternative C. natural disturbances such as fire, floods, blowdown, and avalanches will continue to be the main change agents to riparian zones in these area.

Alternatives B, C, D

The additions of recommended wilderness areas especially in Alternative C where 506,900 acres are recommended will likely confer beneficial effects to riparian areas. However, these acres are largely roadless now and there is no active management so impacts to riparian resources have not occurred other than by natural disturbances. Recommending these areas will assure that wilderness character is maintained and will provide protection rather than improvement of riparian conditions Alternative D would be the least beneficial alternative for protecting riparian areas within recommended wilderness areas as none is proposed.

Effects on riparian areas from livestock grazing

Alternative A

There are nine active allotments on the Forest. Seven of the nine allotments have been inactive for periods over the last five years so exposure to detrimental effects on riparian zones have been limited. Monitoring of allotments over the last decade has shown some stream bank alteration and reduction in stubble height. In addition, there is elevated percent fines and D50 as monitored at the PIBO locations. Alternative A, if selected, will continue to have a minimal effect on riparian areas as a whole however, localized reduction in stubble height and shrub components may continue to occur unless stream sections are fenced.

Alternatives B, C, D

Incorporation of Best Management practices into project level analysis will minimize the effects of grazing on aquatic resources in all action alternatives.

As mentioned above under water quality, there are three guidelines specific to grazing (FW-GDL GR 3, 4, and 5) that would help to reduce impacts on riparian conditions. These guidelines would reduce bank trampling and minimize livestock operations within RMZs thus there would be less compaction and loss of vegetation. Vegetation within RMZs is important for sediment filtering and shade. .

Watershed conservation practices and updated grazing standards and guidelines designed to protect water quality and riparian areas, where needed, will be included in allotment-management plans as they are revised and updated. The plan components for grazing that may affect aquatic resources are consistent across alternatives.

Monitoring has shown that the proper implementation of livestock grazing standards leads to improved stream conditions. There will be no differences in effects between action alternatives other than Alternative D may create more transient forage since more land is in MA6, however the forage would be away from the creeks due to limited harvest within the RMZs. Existing allotments are in MA6b and 6c.

Effects on riparian areas from minerals and oil and gas

Alternatives A, B, C, D

There are no active leases on the forest and no effect on riparian areas from any of the alternatives. Generally, gravel pits are situated away from riparian areas and tend not to have watershed or riparian impacts. There are no effects on riparian areas from any of the alternatives from the free use permits to the general public.

Effects on riparian areas from recreation

Alternative A

INFISH amended the forest plan in 1995 and provided three standard and guidelines for recreation management mainly relocating or constructing new developed and dispersed sites outside of riparian areas. These standard and guidelines have been effective at maintaining aquatic and riparian resources and no developed recreation sites have needed to be relocated due to adverse impacts to fish. Most dispersed and developed sites are located within riparian areas; the ground is often hardened and ground vegetation may be removed however, we have not identified areas where excessive sediment from these sites is a concern. Dispersed sites typically do not have toilet facilities and we have found concentrations of human waste at some locations. Trees have been felled for safety reasons in campgrounds and will continue to be felled for safety reasons. Once again this impact is limited in nature and monitoring does not show that large wood is limited from our streams. Alternative A would continue to address recreational activities within riparian areas which lost some riparian vegetation from human use.

Alternatives B, C, D

Standard and guidelines are designed to mitigate these types of general effects under all action alternatives. For example, two guidelines (FW-GDL-REC 07 and 08) deal with recreation facilities inside of RMZs to either improve conditions or re-locate facilities if improvements cannot be made.

However, it is assumed that minor, localized impacts to, riparian vegetation, woody debris, and water quality would still occur where recreation use and activities are allowed. Existing recreational facilities and actions within or affecting RMZs may need to be modified, discontinued, or relocated if they are identified as not fully meeting functional aquatic/riparian conditions and processes, or improving conditions and processes. Modification or relocating facilities may cause temporary affects to streams and riparian areas. Where facilities cannot be located outside of RMZs, effects would be minimized to the greatest extent possible, but not completely eliminated.

Effects on riparian areas from motorized and non-motorized winter recreation

Alternatives A, B, C, D

The forest has identified very few impacts from winter recreation on riparian areas while implementing the 1986 plan as amended. There would be no effects from any of the alternatives on riparian areas largely because winter use does not result in ground disturbing activities as it occurs over snow.

Effects on riparian areas from hiking and stock (non-motorized) trails

Alternatives A, B, C, D

Trails typically have very little impact on riparian resources. Trails commonly parallel streams and/or lakes and often occur within riparian areas. Although vegetation is removed along the trail itself, recreational use of the trails does not result in any effects to riparian function. These impacts are localized and with riparian processes or function remaining intact.

Effects on riparian areas from travel management

Alternative A

Roads have had the greatest impact to riparian resources, especially roads that are within floodplains where riparian vegetation has been removed. Fortunately, the glaciated geology of our Forest has allowed for roads to be located largely on old terraces rather than in constricted valley bottoms as seen in most of southwest Montana. There are not very many roads paralleling streams on the forest and most roads in riparian areas are stream crossings. Alternative A would continue to move to meet A19 standards in those grizzly bear subunits that don't meet road standards. Riparian areas would benefit by decommissioning roads in riparian areas since vegetation would be re-established. Removal of culverts at stream crossings would also re-establish riparian vegetation.

Alternatives B, C, D

Impacts to riparian vegetation from new road construction should be few due to limitations set forth in the Primary Conservation Area for grizzly bears and guidelines limiting roads in RMZs. Maintenance, reconstruction and decommissioning all address the existing forest transportation system and are expected to influence riparian resources more than road construction over the planning period. Plan components developed to minimize impacts from roads on riparian conditions is a central focus of the plan. Some key guidelines (FW-GDL-IFS 02 and 03) are designed to minimize roads, landings, skid trails and other harvest activities within RMZs to reduce potential sediment inputs and compaction.

Relocation of roads within riparian areas will be a priority for watershed restoration which will greatly improve riparian conditions and floodplain processes. There will be no net increase in the road network and stream crossings inside of RMZs for watersheds within the Conservation Watershed Network.

Effects on riparian areas from lands and special uses

Alternatives A, B, C, D

Land and special uses guidelines (FW-GDL-LSU 02, 03, and 04) are similar for each alternative as they were modified from alternative A which adopted the INFISH guidelines in 1995 under amendment to the 1986 plan. These guidelines look at existing and new facilities and their potential impacts on RMZs and strive to improve conditions or re-locate them outside of RMZs. Some riparian vegetation is removed or curtailed from re-establishing due to clearing of power lines, outfitter camps, etc. that overall is minor and will not affect riparian processes. Acquisition of areas along the Wild and Scenic River program will continue to be a priority for the lands program.

Existing facilities and actions within or affecting RMZs may need to be modified, discontinued, or relocated if they are not maintaining or improving fully functional aquatic/riparian conditions and processes. Modification or relocation of facilities may cause temporary affects. Where facilities cannot be located outside of RMZs, effects would be minimized to the greatest extent possible, but not completely eliminated.

Effects on riparian areas from restoration projects

Alternative A

INFISH amended the 1986 plan to include four guidelines for restoration. Restoration actions since that time have primarily focused on culvert removals, road decommissioning, road relocation and slump stabilization. Much of the restoration efforts have been focused in riparian areas and these activities resulted in benefits to riparian areas functions and stream processes. Future benefits are expected under Alternative A.

Alternatives B, C, D

The highest priority for restoration actions would be within the Conservation Watershed Network to benefit native fish. Riparian areas in these watersheds would receive the greatest benefits and actions would focus on stream crossings. The benefit of re-establishing riparian vegetation at these sites would not vary between alternatives.

Effects on riparian areas from timber and vegetation management

Alternative A

The forest has had very limited riparian harvest since 1995 when INFISH amended the 1986 plan. Riparian Habitat Conservation Areas were established that limited timber harvest within RHCAs except for salvage or where silvicultural practices were needed to attain Riparian Management Objectives. Generally, entry into RHCAs occurred where a road bisected an RHCA and harvest or salvage then occurred above the road but not below the road. The primary reason for this was to reduce impacts that would occur from firewood harvest from cutters winching trees to the road which scoured soil and plugged ditches. Entry into RHCAs also occurred within the Wildland Urban Interface to reduce fuels. This resulted in thinning to protect structures and create defensible space. Lastly, entry occurred for safety reasons to reduce hazard trees. Under Alternative A, this direction would continue and riparian areas would be protected under INFISH with the appropriate widths. Monitoring data from PIBO demonstrates that stream habitat conditions (temperature, LWD, pool frequency, etc.) associated with riparian protections have trended in a positive change on the forest (Kendall 2014)

Alternatives B, C, D

The action alternatives will provide a greater level of protection for aquatic and riparian resources than alternative A since the RMZ will be increased to 100’ for intermittent streams in all watersheds, whereas it was 50’ or 100’ in priority watersheds under Alternative A. There will also be a 300’ RMZ on all ponds and wetlands regardless of size which is a change from Alternative A. Riparian Management Zones are not exclusion zones but forest management is allowed to occur with greater flexibility in the outer half of RMZs. Standard and guidelines would help mitigate these types of general effects under all alternatives. Vegetation management inside of RMZs would need to look at the condition of the riparian vegetation as well as stream conditions and should not degrade those conditions. This is a multi-scale, multi-resource review before any action can proceed and guided by the following standards FW-STD-RMZ 02 and 03 designed to provide long term protections to riparian areas.

The risk of adverse consequences to riparian areas increases with higher timber harvest levels. Alternative C has the highest risk of potential adverse effects to riparian resources from timber harvesting followed by Alternatives A and B due to the amount of acres in the suitable base as identified primarily in MA6b and 6c where most of the suitable base is in the Salish GA; Alternative D would have the least risk due to the fewest number of acres harvested. However, the analysis is confounded by the fact that Alternative D has the highest volume predicted from the model due to higher intensity harvest albeit on fewer acres. Riparian areas are not part of the suitable base. All action Alternatives have riparian area plan components that will permit less ground disturbance and will provide protection to riparian areas

Project specific BMPs shall be incorporated into road maintenance activities to protect riparian values. Ground-based mechanized equipment used for logging or mechanical fuels reduction may enter the outer half of an RMZ only at designated locations except to cross, and if necessary for the attainment of RMZ desired conditions. Log landings, designated skid trails, new roads, including new temporary roads, and new motorized trails would generally avoid RMZs, unless needed to cross streams. Actions may also occur where the risk of short-term effects is worth taking because there would be significant benefits to watershed resource conditions over the long term. For example, riparian management may thin lodgepole pine that would allow larger conifers to grow which would provide large wood to streams.

Effects on riparian areas from fire management

Alternatives A, B, C, D

The forest has experienced an increase in large fires over the last two decades. Generally, riparian areas burn at lower intensity than the surrounding uplands due to higher humidity next to the stream.

Standards and guidelines would mitigate general fire management effects under all alternatives. There is no differences in effects between alternatives because it is nearly impossible to predict the extent and location of large wildfires. However, it is assumed that impacts to riparian areas would still occur where fire management activities, primarily suppression efforts take place. Impacts to RMZs and habitat may still occur in certain circumstances when no other suitable locations for incident bases, camps, heli-bases, staging areas, etc., exists. Delivery of chemical retardant, foam, and other additives near or on surface waters may occur when there is imminent threat to human safety and structures or when a fire may escape causing more degradation to RMZs, than would be caused by addition of chemical, foam or additive delivery to surface waters in RMZs. Conversely, where management treatments are used to reduce wildfire hazard, positive long-term effects to riparian areas by not burning may be realized.

Effects on riparian areas from noxious weed treatments

Alternatives A, B, C, D

Riparian vegetation, especially aspen stands can be susceptible to mortality from herbicides, therefore chemicals are discouraged from use within RMZs. Guideline FW-GDL-NNIP-01 would consider use of mechanical, biological, and cultural means of control before chemical control methods to minimize effects to riparian areas:

Effects to riparian areas from noxious weed treatments would be the same across all alternatives because previous standards under alternative A were carried forward and effects to riparian area should be minimal due to limited use of chemicals within riparian areas.

Effects on riparian areas from wildlife management

Alternatives A, B, C, D

Riparian areas have benefited from wildlife management such as road decommissioning under Alternative A and would continue to receive benefits as the forest strives to achieve amendment 19. Benefits would be the same across the action alternatives since plan components affecting wildlife and riparian areas do not differ between alternatives.

3.2.10 Wetlands environmental consequences

Effects of forestwide direction on wetlands

Background

The first legal protection of wetlands came from President Jimmy Carter in 1977. He signed Executive Order 11990 into law requiring Federal government agencies to take steps to avoid impacts to wetland when possible. Then, in 1989 President George H. W. Bush established the National policy of “no-net loss of wetlands”. Section 404 of the Clean Water Act (CWA) establishes a program to regulate the discharge of dredged or fill material into waters of the United States, including wetlands.

Alternatives A, B, C, D

Under alternative A, wetlands are protected by the Conservation Strategy *Howellia aquatilis* signed in 1994 which requires a minimum 300’ buffer width around all ponds that support *Howellia*. INFISH has either a 150 foot RHCA or 50 foot RHCA depending if the wetland is greater than one acre. The action alternatives would protect wetlands with a 300 foot RMZ for all mapped wetlands and any wetlands identified during project reconnaissance and layout.

Effects on wetlands from timber and vegetation management

Background

A key factor that determines wetland type and function is water regime. Water regime pertains to the depth, duration (hydroperiod), frequency, diurnal fluctuation, and seasonal timing of groundwater and surface water. A large suite of variables – not just water yield, peak flow, and base flow -- have been used as “indicators” to describe hydrologic change in watersheds, streams, and rivers (Konrad et al. 2005, Poff et al. 2006, 2010, Poff 2009, Poff and Zimmerman 2010, Gao et al. 2009, Merritt et al. 2010). A similarly large number could be used to characterize changes in wetlands. In general terms, some indicator variables that apply to estimating the hydrologic effects of vegetation management on wetlands include:

- volume of water inputting to wetland (i.e., water yield of contributing area) and its timing
- peak water level or flow within the wetland: magnitude (depth or rate) and timing
- minimum water level or flow: magnitude (depth or rate) and timing
- percentage of days annually with surface water or measurable flow (both continuous and total)
- fluctuation (variance) in water level or flow: daily or annual
- percent of wetland water budget derived from groundwater vs. surface runoff vs. direct precipitation (and snow vs. rain)

Small isolated headwater wetlands are perhaps most at risk from hydrologic changes occurring in their catchments because their hydrologic inputs are usually the least. In glaciated landscapes such as the Flathead, some wetlands that comprise only one-third of their catchment area can produce 50-70% of the annual streamflow, because wetlands often occur where groundwater intercepts the land surface (Verry and Kolka 2003).

Many but not all studies have shown that removal of trees near a stream or in a wetland causes a mean annual rise in the local water table (Stednick 1996 and 2008, Miller et al. 1997, Scherer and

Pike 2003, Moore and Wondzell 2005, Guillemette et al. 2005, Brown et al. 2005, National Research Council 2008, Grant et al. 2008, Mallik and Teichert 2009, Smerdon et al. 2009, Troendle et al. 2010, and Winkler et al. 2010). As regeneration occurs in cutover areas, the previous rates and amounts of water transfer between uplands and wetlands return. This usually begins within 3-7 years post-harvest (Beschta 2002) -- less if the area has not been clearcut (Thomas and Megahan 1998). Hydrologic recovery to pre-harvest conditions takes 10 to 20 years in some coastal watersheds but may take many decades longer in mountainous, snow-dominated catchments (Whitaker et al. 2002, Moore and Wondzell 2005).

The probability of a harvest operation having an effect on a wetland’s water regime is greatest if trees are removed directly from a wetland or, if removed from outside the wetland, the removal occurs close to and upslope from the wetland. Several other factors influence the degree to which tree removal causes water tables to rise. Especially on windy south-facing forest edges during the summer, tree roots can transfer large amounts of soil moisture to foliage and then to the atmosphere via transpiration and evaporation (Keim and Skaugset 2003). This effectively removes some of the water before it can reach wetlands and streams. Trees also intercept significant volumes of rain and especially snow, allowing some of that retained water to evaporate before it can reach wetlands and streams located farther downslope (Troendle and King 1987, Winkler et al. 2005). Thus, when trees are removed from within or above a wetland that potential source of liquid water becomes available, the water table often rises, and the wetland may receive more water.

This has been suggested by the data from many studies of streams and watersheds in the Pacific Northwest, such as those by Hetherington (1982, 1987), Jones and Grant (1996), Troendle and Reuss (1997), Thomas and Megahan (1998), Beschta et al. (2000), Hudson (2001), McFarlane (2001), and MacDonald et al. (2003). If resulting increases in peak flows are great, the morphology of channels can be affected (Grant et al. 2008). This can create, expand, or shrink wetlands. Depending on the soils and topography, the slashburning and soil compaction components of some harvest operations provide additional surface runoff to wetlands, at least during a few years post-harvest (Lamontagne et al. 2000). In addition, in snow-affected areas, clearcuts have sometimes been shown to cause greater runoff during rain-on-snow events (Berris and Harr 1987) and earlier peaking of streamflow (or wetland water levels).

On the other hand, harvest might measurably reduce runoff to streams and wetlands in some parts of the Pacific Northwest during low runoff periods, partly by temporarily eliminating trees that otherwise contribute water by intercepting fog (Harr 1982, 1983). During the autumn, streams in clearcut watersheds in the PNW tend to have lower flows than in uncut watersheds (Harr et al. 1975). Also, cutting or windthrow of trees in or near wetlands can increase open-water evaporation sufficiently to reduce water persistence in late summer (Petrone et al. 2007), especially in larger wetlands and/or in drier parts of the PNW.

Alternative A

Wetlands are protected under the Conservation Strategy Howellia aquatilis signed in 1994 which requires a minimum 300’ buffer width around all ponds. Howellia can only be found in the Swan River drainage on forest. INFISH amended the forest plan in 1995 and protects wetlands greater than 1 acre with 150’ Riparian Habitat Conservation Areas (RHCAs) and 50’ RHCAs on wetlands less than 1 acre if Howellia is not present. Standard and guideline TM-1 in INFISH allows salvage and fuelwood cutting as well as silvicultural practices in RHCAs if adverse effects to fish could be avoided. Ground disturbing activities around Howellia ponds are to be avoided. This direction would continue under Alternative A.

Alternatives B, C, D

Riparian Management Zones (RMZs) would replace RHCAs and the Conservation Strategy Howellia aquatilis would be retained. RMZs would be increased to 300’ for all wetlands regardless of size to recognize the unique ecological value of wetlands. If entry into RMZs for vegetation management occurs, it would be guided by FW-STD-RMZ 2 thru 4 which would assure impacts to wetlands are minimized by meeting the state SMZ law and restoring or enhancing riparian resources. Expanding widths to 300’ for all wetlands would assure that hydrologic processes that influence wetlands as described above under the background section would not be affected.

Effects on wetlands from access management and roads

Background

Construction of new roads accompanies many timber harvests. Depending on how roads are designed, constructed, and maintained, the effects of roads on wetlands and watershed hydrology can be undetectable or significant, and they can be short-term or long-term (Schuldiner et al. 1979). Roads can change the volume and/or rate of runoff, its timing, and the proportion of precipitation that infiltrates and becomes groundwater rather than runoff. These effects can rival or exceed those of the harvests themselves. Road-diverted flow paths often directly or indirectly lead runoff into wetlands, streams, or onto downhill slopes.

Roads may alter the subsurface flow as well as the surface flow on wetland soils (Swanson et. al 1988). Compacted saturated or nearly saturated soils have limited permeability and low drainage capacity. Wetland road crossings often block drainage passages and groundwater flows, effectively raising the upslope water table and killing vegetation by root inundation, while lowering the downslope water table with accompanying damage to vegetation (Swanson et. al 1988).

The hydrologic effects of new roads are attributable to the following processes (NCASI Forest Watershed Task Group 2003):

- slowing and occasional impounding of runoff and channel flow,
- connecting, by means of excavated roadside ditches, of existing natural drainage ways that run perpendicular to the road,
- excavating into slopes and subsurface water flow paths, which causes more water to flow on the land surface, and
- removing vegetation, just as logging does, with consequent changes in water table height.

Essentially, roads can increase peak stream flows by replacing subsurface flow paths with surface flow paths, doing so through capture of subsurface water in road cuts and by reducing the rate of infiltration into compacted surfaces.

Runoff from roads generally follows one of four pathways: infiltration back into the hillslope below the road with no delivery to streams; direct delivery at channel crossings; direct delivery through gullies formed below cross drains; or indirect delivery via overland flow below the road. Direct delivery at channel crossings is the most common and most rapid form of delivery, and occurs where roadside ditches and/or road tread runoff are directed to the stream crossing structure, whether it is a culvert, bridge, or ford. Delivery at stream crossings is controlled partly by the spacing of cross drains. Direct impacts to wetlands occur if sediment is routed to them or if roads cross wetlands.

Alternative A

The Conservation Strategy Howellia aquatilis prohibits ground disturbing activities within 300' of occupied ponds. INFISH standard and guideline RF-2a requires a watershed analysis prior to construction of new roads in RHCAs and RF-2b minimizes road and landing locations in RHCAs which have limited impacts to wetlands by reducing potential sediment, compaction, and vegetation removal. These standards and guidelines would continue to provide wetland protection under Alternative A.

Alternatives B, C, D

Riparian Management Zones (RMZs) would replace RHCAs and the Conservation Strategy Howellia aquatilis would be retained. RMZs would be increased to 300' for all wetlands regardless of size to recognize the unique ecological value of wetlands. FW-GDL-IFS-14 assures that roads should be designed to maintain natural hydrologic flow paths so wetlands cannot be disconnected from water regimes. FW-GDL-IFS-10 assures that wetlands are avoided when roads are being constructed or reconstructed and FW-GDL-IFS-10 minimizes sediment delivery to riparian areas and wetlands. The addition of these standards in all action alternatives and the increase in RMZ widths will provide greater protection to wetlands and wetland functions than Alternative A, however there is no difference between action alternatives because the plan components are the same.

It is nearly impossible to tease out differences between alternatives for new road construction or temporary road construction because timber volume is greatest for Alternative D while timber harvest acres is greatest for Alternative C over the two decades that are modelled. The location of the road in relation to any wetlands if any would be the most important factor and the guidelines would provide protection.

Effects on wetlands from grazing

Alternatives A, B, C, D

Wetlands provide forage for cattle and impacts can be seen from soil compaction and trampling. Noxious weeds are commonly transported by cattle and can be introduced into wetlands. There areseven active allotments on the forest on the Swan Lake and Tally Lake Ranger Districts. There are forested wetlands and fens within the allotment area boundaries. Alternative A has three standards and guidelines under INFISH that require that grazing practices be modified to if hey prevent the attainment of Riparian Management Objectives. The action alternatives brought forward the grazing direction (FW-STD-GR-07 and 08) to reduce impacts to riparian areas and wetlands by modifying the practice if impacts are occurring and by relocating livestock operations outside of riparian and wetlands to reduce soil compaction, bank trampling and to allow riparian vegetation to provide streambank cover and stability.

Effects on wetlands from other resources

The effects on wetlands from other resources such as oil and gas, restoration, wilderness, noxious weeds, wildlife management, and recreation are the same as the riparian section since wetlands are a type of riparian area and can be found in those sections above.

3.2.11 Aquatic species environmental consequences

Effects of forestwide direction on aquatic species

Alternatives A, B, C, D

The greatest benefit to aquatic species occurs where non-native species do not negatively impact native populations. The effects of plan components on aquatic species do not vary between alternatives. Although Alternative D proposes more timber harvest and the potential to generate more Knutsen-Vandenberg revenue for restoration actions such as BMPs, road decommissioning and culvert replacements that would benefit aquatics; however it is anticipated that money would still be available from partnerships and appropriated watershed dollars to implement restoration projects regardless of hum much money is generated from timber sales. Conversely, Alternative C may provide greater protection for aquatic resources because more wilderness is proposed, however, the standards and guidelines that are the same in each action alternative are designed to protect riparian and aquatic resources based upon past monitoring. Wilderness does provide the ultimate degree of resource protection for aquatic resources.

The most significant change between action alternatives and the existing plan (Alternative A), is the incorporation of forest wide standards and guidelines that are specifically designed to protect aquatic resources. The impacts to aquatic resources from alternatives B, C, and D would provide a greater level of protection for aquatic and riparian resources than alternative A and will provide additional riparian protection since the RMZ will be increased to 100’ for intermittent streams in all watersheds. There will also be a 300’ RMZ on all ponds and wetlands regardless of size which is a change from Alternative A. Riparian Management Zones are not exclusion zones but forest management is allowed to occur with greater flexibility in the outer portion of RMZs. Guidelines (FW-GDL-RMZ 01 and 02) are designed to protect riparian and aquatic resources by taking a multi-scale, multi-resource hard look at stream habitat and riparian conditions prior to entry.

The Conservation Watershed Network (appendix E) provides a network of watersheds designed to emphasize conservation of westslope cutthroat and bull trout by protecting and restoring components, processes, and landforms that provide quality habitat. The objective for selecting Conservation Watersheds is to provide long term protection for native fish to a distributed group of the strongest populations across the Forest. These watersheds will include the entire South Fork of the Flathead River drainage and all bull trout watersheds that have designated “critical habitat” stream reaches. An objective of the Watershed Conservation Network is to identify and conserve watersheds that will have cold water to support native fish into the future in the face of climate change. Isaak et al. (2015) identified bull trout and westslope cutthroat trout probabilities of persistence into the future under different climate warming scenarios as well as cold water refugia. The Climate Shield Model (Isaak et al. 2015) was used as a starting point to identify watershed with cold water that may persist into the future. A key strategy in these watersheds is no net increase in the road network and stream crossings as identified in guideline, FW-GDL-CWN01. Reducing roads would reduce potential sediment inputs and benefit aquatic species.

Restoration activities will focus on “storm proofing” the existing road network in light of climate change. Maintaining migratory life histories is an important element of conservation. Thus, selecting numerous watersheds rather than a select few provides the greatest opportunity to maintain connectivity and a migratory life history. Watersheds with bull trout and westslope cutthroat trout populations which are, or are nearly genetically pure, match up nicely with the Primary Conservation Area for grizzly bears which will also limit the road network.

The no action alternative did not consider impacts from non-native and invasive species and plan components such as Guidelines (FW-GDL-WTR 10, 11, and 12) would help educate the public about AIS and provide for disinfection of road and fire equipment when they arrive on forest. The action alternatives should help detect these species and reduce invasion.

Spread and introduction vectors are inherent to most projects and types of forest use. Thus, components of the plan require mechanisms for addressing aquatic invasive species. More general or universal objectives and procedures, such as using current best practices for equipment washing before and after entering an area, are recommended for inclusion in the fish and aquatic wildlife sections of the document. This better assures that these components are included as resource protection measures at the project level. These activities would include, but aren't limited to: transporting water across drainage boundaries for fire suppression, constructing stream fords, operating equipment in a riparian area and near a water course, and the use of pumps and sumps for fire suppression, or construction related dewatering activities.

Effects of additional recommended wilderness on aquatic species

Alternatives A, B, C, D

The best remaining trout habitat conditions are found in wilderness and unroaded landscapes (Rhodes et al., 1994; NMFS, 1995; Hitt and Frissell, 1999; Kershner et al., 1997; Kessler et al., 2001). Across the West, roadless areas tend to contain many of the healthiest of the few remaining populations of native trout, which are crucial to protect (Kessler et al., 2001). Roadless areas are a source of high quality water essential to the protection and restoration of native trout. The high quality habitats in roadless areas help native trout compete with non-native trout, because degraded habitats can provide non-natives with a competitive advantage (Behnke, 1992). Roadless areas tend to have the lowest degree of invasion of non-native salmonids (Huntington et al. 1996). Unroaded areas also act as the foundation for the needed restoration of larger watersheds.

Most of our strongest fish and purest westslope cutthroat trout populations are within the designated Bob Marshall Wilderness Complex. There is a strong correlation between healthy fish populations and wilderness/low road densities (Lee et al. 1997).

Alternative C would provide the greatest benefit to aquatic species because it proposes the greatest amount of recommended wilderness while Alternative D would be the least beneficial.

Effects on aquatic species from livestock grazing

Alternative A

There are nine allotments on the Forest; there is only one allotment (Piper Creek) that is within a bull trout watershed that only has 26 cow/calf pairs. Holland Lake Allotment is below Holland Lake and thus has no effect on bull trout since bull trout occur in the lake and directly in the mouth downstream from Holland Falls. Seven of the nine allotments have been inactive for periods over the last five years so exposure to detrimental effects on riparian zones and fisheries have been limited. The allotments are in the Swan, the Swan Island Unit, and Tally Lake RD and include streams that only support brook trout. Westslope cutthroat trout are not present except for Piper Creek. Alternative A if selected will continue to have a minimal effect on native aquatic species as the number of allotments and AUMs will not change.

Alternatives B, C, D

Effects to fisheries would be similar to alternative A as the standard and guidelines from INFISH for grazing were carried forward under these alternatives. The plan components are shown above under effect to water quality from livestock grazing.

Effects on aquatic species from minerals and oil and gas

Alternatives A, B, C, D

There are no active leases on the forest thus no effect on aquatic species from any of the alternatives. Generally, gravel pits are situated away from riparian areas and tend not to impacts on aquatic species. There are no effects on fish from any of the alternatives from the free use permits to the general public.

Effects on aquatic species from recreation

Alternatives A, B, C, D

Montana Fish, Wildlife, and Parks has laws and regulations that are adequate to prevent over-exploitation of fish populations through angling with catch and release fishing for westslope cutthroat trout throughout most of the forest. Fishing for bull trout is only allowed within the South Fork Flathead. There is some incidental mortality to fish when they are caught and released. Habitat alteration from recreational camping and day use sites might cause some site-specific impacts, but should not extensive enough to measurably limit fish populations. Localized impacts to vegetation and banks in riparian areas occur at lakes with trout and at river access sites. Effects would be the same between all alternatives. There would be little to no effects on aquatic and riparian resources from fishing.

Increases in recreational visitors increase risks to aquatic communities. The greatest threat from recreation is introduction of aquatic nuisance species. These species include any non-native plant or animal species and disease which threaten the diversity or abundance of native species, the ecological stability of infested waters, or commercial, agricultural, or recreational activities dependent on such waters. The Montana Aquatic Nuisance Technical Committee (2002) identifies over 70 nuisance species. Some, well known in Montana, include the New Zealand mudsnail, curley-leaf pondweed, whirling disease, and non-native fish. While non-native fish like brook and rainbow trout are desirable in many locations, there are places where they are not. An environmental assessment by the MFWP is now required before fish introductions can legally occur.

Most of the pathways of introduction and spread of aquatic nuisance species are related to human activities, both accidental and intentional. The New Zealand mudsnail and whirling disease can be accidentally transported and spread by way of recreational boats and wading boots. The Forest will continue to support check stations for aquatic invasive species.

Effects on aquatic species from motorized and non-motorized winter recreation

Alternatives A, B, C, D

The forest has identified very few impacts from winter recreation on aquatic species. Effects would be the same between all alternatives since there is no effects on aquatic species largely because winter use does not result in ground disturbing activities as it occurs over snow.

Effects on aquatic species from Developed winter recreation

Alternatives A, B, C, D

Winter recreation doesn't have an effect on aquatic species except for possible sediment inputs resulting from grooming or maintenance of ski areas. The effects would be the same across all alternatives.

Effects on aquatic species from hiking and stock (non-motorized) trails

Alternatives A, B, C, D

Trails typically have very little impact on aquatic species. The forest does see sediment and erosion from trail use that mainly gets routed into the forest with no impact to water quality and thus no impact to aquatics. Once again these impacts are localized and do not result in impacts to species. Spread of invasive species is not a concern from hikers and stock use although, noxious weeds are. Spread of noxious weeds and resultant treatment is a concern. Use of chemicals is discouraged in RMZs. Effects would not differ between alternatives.

Effects on aquatic species from travel management

Alternative A

Roads have the greatest impact to aquatic species due to increases in sediment and by blocking upstream migration to spawning grounds. The forest has made great strides over the last two decades under the 1986 plan to provide fish passage by removing or replacing culverts. Standards and guidelines in Alternative A from INFISH would be carried forward and would continue to strive for fish passage, upsizing of culverts, BMPs, etc. that would be beneficial for aquatic species. Detrimental effects would continue to occur to aquatic resources when culverts fail or roads slump. Monitoring of sediment from McNeil core samples and PIBO has shown a decreasing trend in sediment levels in most locations.

Alternatives B, C, D

Maintenance, reconstruction and decommissioning address the existing forest transportation system and are expected to influence aquatic resources more than road construction over the planning period. Plan components developed to minimize impacts from roads on aquatic species is a central focus of the plan.

FW-GDL-CNW-01 has no net increase in roads or crossings in the Conservation Watershed Network. FW-GDL-IFS 02, 07, 09, 13, and 15 focus on the road system and assure that roads are hydrologically disconnected from the stream network as well as provide for passage of fish.

The total miles of roads and motorized trails are expected to be less under Alternative C. This will benefit aquatic resources due to the decreased risk of road and trail related sediment. Alternative D has the greatest potential to adversely affect aquatic resources from motorized routes due to anticipated needs to meet timber harvest and construct temporary roads or new roads. Management Areas 6b and 6c would be the areas where we could see the greatest number of roads constructed to support timber harvest. Inside the PCA for grizzly bears there will be no net increase in the road network for Alternatives B and C. Lastly, there will be no net increase in the road network and stream crossings inside of RMZs for watersheds within the Conservation Watershed Network.

Off trail use is very limited on the Flathead National Forest due to the direction in the the Motor Vehicle Use Map. The Swan Island Unit near Blacktail has a network of trails for off road use and the use is located on ridge tops and away from streams so there is little impact to watershed conditions. There are no native fish within the off trail area and thus no effects.

Effects on aquatic species from lands and special uses

Alternatives A, B, C, D

Special-use permits can allow for hatchery facilities such as the Sekokini Springs facility which is used for conservation of westslope cutthroat trout thus providing great benefits for native fish. Impacts to aquatic resources would be associated with impacts to riparian areas as discussed above. Other potential impacts would be through special use permits to outfitters who guide fishermen and from whitewater rafting. Effects would be the same for all alternatives as plan components are the same and have not changed markedly from the INFISH amendment.

Effects on aquatic species from restoration projects

Alternative A

INFISH amended the 1986 plan to include four guidelines for restoration. Restoration actions since that time have primarily focused on culvert removals, road decommissioning, road relocation and slump stabilization. These activities resulted in improved fish passage and sediment reduction. These activities would continue under Alternative A.

Alternatives B, C, D

Restoration effects can be of a long term positive effect but be of a short negative nature; typically short term effects occur during implementation by increasing sediment, however, long term sediment reductions are accrued. Standards and guidelines would mitigate the general negative effects described above under all alternatives. Alternative C would have the most recommended wilderness and potentially the fewest impacts and thus the lowest need for restoration activities. Alternative D would potentially have the greatest impact due to timber harvest, however, the standards and guidelines would limit road construction and thus restoration associated with new actions most likely would not be needed. Alternative D would have the most active forest management and would generate more money that funds stewardship projects. Stewardship funding is currently a tool often used for restoration projects as well as appropriated dollars for watershed and fisheries. If more money is available from Alternative D then there would be more short term impacts from restoration projects but there would be more long term gains. The highest priority for these restoration actions would be within the Conservation Watershed Network to benefit native fish. It is expected that temporary and short-term impacts to fish, stream channels, water quality, etc. from culvert removals, in-channel restoration, and habitat surveys will still occur. It is also expected that long-term positive effects would occur from these restoration activities.

Effects on *aquatic species from timber and vegetation management*

Alternative A

Alternative A has the highest risk of potential adverse effects to aquatic resources from timber harvesting not from vegetation removal but due to the potential of associated road construction. This would be primarily in Tally Lake and the Swan Island Unit where there is only a handful of native fish populations so impacts to native fish would be limited. Timber harvest and vegetation management is currently limited inside of RHCAs due to INFISH standards, therefore effects to riparian and aquatic resources since 1995 have been limited and will continue to be protected through the same standards.

Alternatives B, C, D

Alternative D has the highest risk of potential adverse effects to aquatic resources from timber harvesting followed by Alternatives A and B due to the amount of acres in the suitable base as identified primarily in MA6; Alternative C would have the least risk due to the amount of recommended wilderness. All action Alternatives have riparian area plan components that will allow less ground disturbance and will provide protection to water quality, stream channels, and riparian areas. However, effective implementation of watershed conservation practices is crucial to avoiding or minimizing impacts to aquatic species and potentially affected streams under any alternative.

Standard and guidelines would help mitigate these types of general effects under all alternatives. Vegetation management inside of RHCAs would need to look at the condition of the riparian vegetation as well as stream conditions and should not degrade those conditions. This is a multi-scale, multi-resource review before any action can proceed and guided by standards (FW-STD-RMZ 03 and 04). Activities within RMZs would need to maintain, restore or enhance conditions and not lead to long term degradation of conditions. These standards and guidelines (FW-GDL-RMZ-01-10) will minimize disturbances inside of RMZs thus assuring recruitment of large wood, shade and ground disturbance which could create sediment.

Forest plan components in all the action alternatives provide direction related to vegetation management activities occurring within RMZs. This direction is expected to maintain RMZ desired conditions or improve conditions where needed, and protect this high value resource. Short-term effects may be acceptable when those activities support long-term benefits to the RMZs and wildlife and aquatic resources. Project specific BMPs shall be incorporated into road maintenance activities to protect riparian values. Ground-based mechanized equipment used for logging or mechanical fuels reduction may enter the outer half of an RMZ only at designated locations except to cross, and if necessary for the attainment of RMZ desired conditions. Log landings, designated skid trails, new roads, including new temporary roads, and new motorized trails would generally avoid RMZs, unless needed to cross streams.

Effects on *aquatic species from fire management*

Alternatives A, B, C, D

The forest has experienced an increase in large fires over the last two decades. Based upon monitoring from FWP following the Red Bench Fire (1988), Moose Fire (2001), and Robert Wedge (2003) juvenile fish populations increased in streams that experienced large fires. This is largely due to an increase in nutrients following the fire. Overall, fire is beneficial to fish as fish have evolved with fire over the last 10,000 years with the exception of the last century due to fire suppression. Impacts to fish are largely a result of fire suppression activities due to increases in sediment, mis-application of retardant, withdrawing water if proper screens are not in place, etc. Standards and guidelines for fire management were first adopted with INFISH (alternative A) and carried forward in this plan. Plan components do not differ between alternatives and the effects will be the same across alternatives: wildfires may result in short term impacts with long term benefits due to nutrients while suppression activities result in impacts that should be mitigated with plan components.

Effects on *aquatic species from noxious weed treatments*

Alternatives A, B, C, D

Chemical treatments are discouraged in riparian areas and are not applied to waterbodies. Guideline (FW-GDL-NNIP-01) would apply to RMZs to minimize effects to water quality by using alternatives to chemicals for treatments within RMZs thus reducing leaching or drift from chemicals into the water thus reducing impacts to aquatic species. Effects to aquatic resources from noxious weed treatments would be the same across all alternatives and should be minimal.

Effects on aquatic species from wildlife management

Alternatives A, B, C, D

Aquatic resources have benefited from wildlife management such as road decommissioning under Alternative A and would continue to receive benefits as the forest strives to achieve amendment 19. Benefits would be the same across the action alternatives since plan components affecting wildlife and aquatic resources do not differ between alternatives.

Bull trout critical habitat is present within the PCA and zone 1, any standard and guideline that limits roads or ground disturbance may provide beneficial effects. There are no potential adverse effects to critical habitat from any of the action alternatives.

Watershed summary of effects by alternatives

The following table provides a summary of the relative impacts of alternatives on riparian and aquatic resources. The land use categories are ranked in descending order of existing and potential impact to water and riparian resources with the greatest effect from travel management listed first.

Table 8. Alternative ranking by benefit or risk to watershed, aquatic species, and riparian resources

Effects from Resource	Less		←RELATIVE SCALE→			More
Effects of travel management			C	B	D	A
Effects of timber management		C		B	D	A
Effects from recreation		C	B D A			
Effects from fire management		C	B D A			
Effects from livestock management			No difference between alternatives			
Effects from noxious weed treatment			No difference between alternatives			
Effects from lands and special uses			No difference between alternatives			
Effects from minerals			No difference between alternatives			
Effects of wildlife management			No difference between alternatives			
Benefits of watershed restoration			No difference between alternatives			
Riparian protection afforded			No difference between alternatives			
Effects from wilderness designation	C		A B D			

Specific outcomes (such as water quantity, water quality, instream and riparian area habitat considerations, and fisheries) from the alternatives pertaining to native fish, lakes, streams, rivers, riparian areas, and wetlands are not predictable without site-specific NEPA analysis on projects. Therefore, effects are very general in programmatic NEPA.

Alternative A does not incorporate a watershed approach to the management of hydrology and watershed processes; there would not likely be watershed scale consideration and protection of hydrologic and riparian area/wetland processes and functions. This would likely result in the continued protection of areas currently in satisfactory condition and areas currently in unsatisfactory would remain unchanged.

Alternatives B, C, and D would emphasize a watershed approach to the management of hydrology and watershed processes and a Conservation Watershed Network to identify important watersheds to conserve native fish.. These alternatives would facilitate management of multiple ecological goals and long term ecological sustainability on a landscape basis. Updated aquatic desired conditions, objectives, standards and guidelines applied in a consistent manner across the forest would provide a mechanism to effectively prioritize activities and weigh multiple risks to various resources.

Alternatives A and D, with their higher activity levels, could pose greater risks to aquatic ecosystems than would the lower activity rates and amounts included under alternative C.

3.2.12 Cumulative Effects

Cumulative effects common to all alternatives

Federal actions within the Flathead River basin above Flathead Lake would involve Glacier National Park and Bureau of Reclamation. Glacier National Park manages headwater streams in the North and Middle Fork Flathead rivers. There would be little to no cumulative effects from park management actions as most areas are managed to protect ecological values. The Bureau of Reclamation manages Hungry Horse Dam and operates a selective withdrawal system that mimics a natural thermographic hydrograph downstream. The dam also releases flows according to an Integrated Rule Curve that provides for aquatic species downstream.

Non-federal land management policies are likely to continue affecting riparian and aquatic resources. The cumulative effects in the Flathead basin are difficult to analyze, considering the broad geographic landscape covered by the areas, the uncertainties associated with government and private actions, and ongoing changes to the region’s economy. Whether those effects will increase or decrease in the future is a matter of speculation; however, based on the growth trends and current uses identified in this section, cumulative effects are likely to increase.

State owned school trust lands managed by the Montana Department of Natural Resources in the Stillwater, Coal, and Swan State Forests, will continue to support a variety of uses from livestock grazing to mining, timber harvest and recreational fishing and hunting. Montana law requires that school trust lands be managed to maximize income for the school trust. Management impacts may be greater on these lands than on other state or federal lands, but may not result in loss of fish populations.

For the most part, the stream systems originate on-Forest in protected headwaters and eventually flow downstream onto lands owned or administered by entities other than the Forest Service and ultimately into Flathead Lake. Many fish populations, whether they move off-Forest as part of their life cycle or remain entirely within a localized area, require interconnectivity of these streams to survive as a population. For most all species, genetic interchange between subpopulations is necessary to maintain healthy fish stocks. The more wide-ranging a species such as bull trout is, the more critical interconnectivity may be in order to access important habitat components. Thus, activities off-Forest that disrupt fish migration corridors can have significant impacts to fish populations upstream.

A host of activities will occur on private lands within the Flathead basin. These include, water diversion; irrigation; livestock grazing; farming with varied cash crops; timber harvest, water based hunting, outfitted and non-outfitted angling, establishment of sub- divisions, housing and commercial development, building and stocking of private fish ponds, chemical treatment of noxious weeds, flood control and stream channel manipulation, and hydropower management.

The potential for introduction of disease and aquatic nuisance species exists on all lands within the cumulative effects analysis area. The extent of influence exerted by disease or exotic species is often determined by an area's suitability. If conditions are favorable enough to promote and perpetuate them, then effects are determined by the fishery's susceptibility to be influenced. The effects of these introductions could range from extreme to negligible, based upon the species. Quagga or Zebra mussels introduced into Flathead Lake could have a devastating effect upon the entire ecosystem.

Montana Fish Wildlife and Parks is the responsible agency for managing fish populations. Regulations will most likely continue to allow angling and harvest of fish, with variations on fishing limits and times when angling can occur and some gear restrictions. Flathead Lake and Swan Lake are critical to maintaining bull trout and westslope cutthroat trout populations in tributaries within the North and Middle Fork Flathead Rivers and Swan River. Fish populations within the lakes are interconnected to upstream ecosystems. How non-native fish, i.e. lake trout are managed within these lakes will largely determine the viability of migratory bull trout and westslope cutthroat trout populations (Bull Trout Recovery Plan 2015).

The most complex cumulative effects relate to the restoration of bull trout and westslope cutthroat trout within the project area. The complexity of these life histories exposes them to many factors affecting their abundance and viability. Cumulative effects to native fish include: (1) predation, hybridization, and competition with non-native fish; (2) destruction or degradation of spawning and rearing habitat from logging, grazing, road construction/maintenance and urban development on private and other non-federal lands; (3) degraded water quality as a result of polluted runoff from urban and rural areas; and (4) migration barriers that result from roads on private or other non-federal lands.

Climate Change

Over the last 50 years, average spring snowpack (April 1 snow water equivalent) has declined and average snowmelt runoff is occurring earlier in the spring. These trends are observed for northwestern Montana, the entire Pacific Northwest, and much of the western U.S. Since the available data is limited to the last 50 years, it is not clear whether these trends are persistent long-term trends or reflect short-term decade-to-decade variability that may reverse in coming years. Several recent studies of the same trends across the entire western U.S. have concluded that natural variability explains some, but not all, of the west-wide trend in decreasing spring snowpack and earlier snowmelt runoff.

Potential changes in streamflow and rising stream temperatures are likely to increase risks to maintaining existing populations of native, cold-water aquatic species. Over the last century, most native fish and amphibians have declined in abundance and distribution throughout the western U.S., including northwest Montana. It is unknown whether, or to what degree, these changes are attributable to climate trends. Potential climate-induced trends of altered streamflow timing, lower summer flows, and increased water temperature will likely reduce the amount, quality, and distribution of habitat suitable for native trout and contribute to fragmentation of existing populations. Climate-related impacts are likely to add cumulatively to other stressors on native fish and amphibian species. Non-native trout and other aquatic species better adapted to warm water temperatures may increase in abundance and expand their existing ranges.

These climatic and hydrologic trends, combined with climate-related trends in wildfires and forest mortality from insects and diseases, can significantly affect aquatic ecosystems and species (Dunham et al. 2003, Dunham et al. 2007, Isaak et al. 2010). A growing body of literature has linked these hydrologic trends with impacts to aquatic ecosystems and species in western North America, often as a result of climate-related factors affecting stream temperatures and the distribution of thermally suitable habitat (Petersen and Kitchell 2001, Morrison et al. 2002, Bartholow 2005, Kaushal et al. 2010, Isaak et al. 2010). Lower summer streamflows and higher air temperatures, as observed over recent decades in northwestern Montana, are generally expected to result in increased stream temperatures.

However, stream temperatures are controlled by a complex set of site-specific variables; including shading from riparian vegetation, wind velocity, relative humidity, geomorphic factors, groundwater inflow, and hyporheic flow (Caissie 2006).

Potential impacts to fish include

Egg incubation and fry emergence may be adversely affected due to flood flows, dewatering, and/or water temperatures. Shifts in the timing and magnitude of natural runoff will likely introduce new selection pressures that may cause changes in the most productive timing or areas for spawning.

Spring/summer rearing may be adversely affected due to reduction in stream flow and higher water temperatures.

Overwinter survival may be positively affected by higher winter water temperatures enabling fish to feed more actively, potentially increasing growth rates if sufficient food is available. If food is limited, the elevated metabolic demands could reduce winter growth and survival.

Bull trout is the native trout species most vulnerable to potential increases in stream temperatures because it has the coldest range of thermally suitable habitat among native salmonids in the Northern Rockies. For this species, increasing stream temperatures may cause a net loss of habitat because areas are not available further upstream to replace those that become unsuitably warm. For rainbow trout, which tolerates warmer stream temperatures better than bull trout and is often limited by upstream temperatures that are too cold, warming may only shift suitable habitats toward higher elevation stream reaches with little or no net change in total amount of thermally suitable habitat (Rieman and Isaak 2010). Cutthroat trout in high-elevation streams currently are commonly limited by low water temperatures and short growing seasons (Coleman and Fausch 2007, Harig and Fausch 2002). These populations may benefit from climate-induced increases in thermally-suitable habitat in higher elevation stream reaches (Rieman and Isaak 2010). However, warmer stream temperatures may also lead to nonnative fish and other aquatic species moving into previously unsuitable upstream areas where they will compete with native species (Rieman et al. 2007, Rahel and Olden 2008, Fausch et al. 2009, Haak et al. 2010).

Projected increases in air temperatures, along with projected decreases in summer stream flows, will likely lead to warmer stream temperatures in the Columbia River basin, particularly during summer low-flow periods (Casola et al. 2005). Recent scientific publications suggest that projected air temperature changes are likely to reduce the distribution of thermally-suitable natal habitat for bull trout, fragment existing populations, and increase risk of local extirpation (Rieman et al. 2007, Isaak et al. 2010). However, the risk of climate-induced extirpation in subbasins of northwestern Montana may be less than other, relatively drier and warmer in the Columbia River basin (Rieman et al. 2007).

Other recent publications conclude that westslope cutthroat trout, which can generally tolerate warmer stream temperatures than bull trout, is at a low risk for increasing summer stream temperatures in most basins within its range, including the Clark Fork (includes all Flathead River drainages) basin of northwestern Montana (Haak et al. 2010). These studies also conclude that stream temperature impacts resulting from projected climate-change-induced increases in wildfire extent and severity posed a moderate or high risk of cutthroat trout extirpation in 46 percent of occupied subwatersheds throughout the species' occupied range and 45 percent of subwatersheds in the Clark Fork Basin (Haak et al. 2010).

Haak et al. (2010) conclude that risks to native trout resulting from projected increases in winter flood risk in northwestern Montana are greater than risks associated with climate-induced changes in wildfire, drought, or stream temperatures. They estimate that cutthroat trout in most subwatersheds in the Clark Fork basin face high to moderate risk of increased winter flooding (Haak et al. 2010).

Effects Determination

Based on the analysis of all alternatives, including the No Action Alternative, other interrelated and interconnected activities, and the cumulative effects of other federal and non-federal activities within the Planning Area it has been determined that the implementation of the plan components, specifically those for riparian areas, Conservation Watershed Network, and roads would provide for ecological conditions that support recovery of bull trout or provide ecological conditions that support persistence of westslope cutthroat trout.

3.3 Vegetation–Terrestrial Ecosystems

Introduction

This section of the EIS addresses the forest and non-forest vegetation component of the terrestrial ecosystems on the FNF. A coarse-filter approach is used, discussing conditions and effects at the ecosystem or plant community level, and how they provide for ecosystem integrity and diversity. These plant communities provide habitat for a host of wildlife species, as well as contributing benefits and services to people.

Legal and administrative framework

The following is a select set of statutory authorities that govern the management of vegetation on NFS lands. They are briefly identified/described below to provide context to the management and evaluation of the resource. There are multiple other laws and regulations and policies not described below that also guide the management of this resource.

Law and executive orders

The Forest and Rangelands Renewable Resources Planning Act of 1974: Provides for maintenance of land productivity and the need to protect and improve the soil and water resources.

The National Forest Management Act (NFMA) of 1976: "It is the policy of the Congress that all forested lands in the NFS shall be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yields. Plans developed shall provide for the diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet the overall multiple-use objectives, and within the multiple-use objective."

"Accordingly, the Secretary is directed to identify and report to the Congress annually at the time of submission of the President's budget together with the annual report provided for under section 8 (c) of this Act, beginning with submission of the President's budget for fiscal year 1978, the amount and location by forests and States and by productivity class, where practicable, of all lands in the National Forest System where objectives of land management plans indicate the need to reforest areas that have been cut-over or otherwise denuded or deforested, and best potential rate of growth. All national forest lands treated from year to year shall be examined after the first and third growing seasons and certified by the Secretary in the report provided for under this subsection as to stocking rate, growth rate in relation to potential and other pertinent measures. Any lands not certified as satisfactory shall be returned to the backlog and scheduled for prompt treatment. The level and types of treatment shall be those which secure the most effective mix of multiple use benefits ."

Other regulation, policy, and guidance

Code of Federal Regulations (CFR): 36 CFR 219.9(a) – Planning Rule: Requires the plan to include components that maintain or restore the ecological integrity of terrestrial ecosystems, including structure, function, composition and connectivity. A complimentary ecosystem and species-specific approach is adopted to maintaining the diversity of plant and animal communities.

36 CFR 219.9(b)(1) – Planning Rule: States that the responsible official will evaluate whether the plan components provide the ecological conditions necessary to contribute to the recovery of federally listed species, conserve proposed and candidate species, and maintain a viable population of species of conservation concern. Evaluation would consider components that provide for ecosystem integrity and diversity (coarse-filter approach) and species specific components (fine-filter approach).

USDA Forest Service Position Statement on National Forest Old-Growth Values 10/11/89: Recognizes the many values associated with old growth forests, such as biological diversity, wildlife and fisheries habitat, recreation, aesthetics, soil productivity, water quality, and industrial raw material. Old growth on the national forests will be managed to provide the foregoing values for present and future generations. Decisions on managing existing old growth forest to provide these values will be made in the development and implementation of forest plans. These plans shall also provide for a succession of young forests into old growth forests in light of their depletion due to natural events or harvest.

Key ecosystem characteristics and indicators

Key ecosystem characteristics are defined in the 2012 planning rule as the dominant ecological components that describe the ecosystems and are relevant and meaningful for addressing ecosystem condition and integrity, as well as important land management concerns. Ecosystem integrity as related to vegetation is typically assessed by considering dominant ecosystem functions, composition, structure and connectivity. Key ecosystem characteristics are also chosen because they are measurable (i.e., quantitative or qualitatively) and we have some type of data or means to distinguish and describe them.

Key ecosystem characteristics for the terrestrial vegetation on the Flathead Forest have been identified and serve as the key indicators for describing the affected environment and evaluating differences among the alternatives. Differences among the alternatives may be expressed as both qualitative and quantitative, and the estimated changes in in the key ecosystem characteristics over time serve as the basis for evaluation of ecological sustainability and forest resilience. The key indicators discussed in this section of the EIS for vegetation are listed below. Descriptions of indicators and how they are measured are provided in their respective sections.

- Vegetation composition: vegetation dominance type (conifer and non-forest types) and tree species presence
- Forest size class and very large tree component: conifer tree d.b.h.[4]
- Old growth forest: as specifically defined by Green and others (1992 with errata)
- Forest density: associated with coniferous tree canopy cover percent
- Snags and downed wood: snags per acre and tons per acre for downed wood
- Landscape vegetation pattern: characteristics of forest patches (size classes/successional stages)

Additional key ecosystem characteristics related to vegetation conditions that are not included in this terrestrial vegetation section of the EIS include those associated riparian areas and wetlands, and with specific plant species that are considered at-risk or of special concern. Riparian areas are covered in section 3.2 of this EIS; threatened, endangered, proposed or candidate plant species, and plant species of conservation concern are covered in section 3.5 of this EIS.

Information Sources

A variety of well documented and accepted vegetation data sources and analysis tools are used for the terrestrial vegetation analysis, collectively comprising the best available science for quantifying vegetation conditions. These sources are briefly described in this section of the EIS, with more descriptions and information found in appendix 2 and in the planning record.

[4] The diameter of a tree 4.5 feet from ground level on the uphill side of the tree.

The Region 1 existing vegetation classification system (R1 VMap) (Barber et al 2011) is the source for classification and spatial mapping of existing vegetation attributes that are utilized in this EIS. The VMap product used for this EIS and for the development of plan components for the revised Flathead Forest Plan represents our best current spatial estimate for the various vegetation components, such as forest size classes and vegetation dominance types. These maps are not static. Vegetative succession and disturbances will change vegetation conditions over time. Newer maps using new methodology or technology may be utilized in the future for a variety of reasons, as determined appropriate, for the spatial portrayal of existing vegetation conditions across the Forest. More detailed information may be incorporated as deemed appropriate into a map of existing vegetation at the project-level of analysis, such as from field inventories.

R1 VMap is derived from National and Regional remote sensing protocols, using a combination of satellite imagery and airborne acquired imagery, with refinement and verification through field sampling. The product is assessed for accuracy, with a known and quantifiable level of uncertainty. Though the product is inherently less accurate and detailed than systematic plot sampling (e.g., FIA), it provides valuable complementary information and allows for an analysis of the spatial distribution of vegetation. It is valuable was designed to allow consistent applications of vegetation classification and map products across all land ownerships. (Barber, et.al. 2009, 2011; Berglund et al. 2009). The primary vegetation classifications in R1 VMAP are vegetation dominance types (composition), tree diameter class, and tree canopy cover class. R1 VMAP used for this EIS is based on 2009 imagery data, with Forest lands updated to the year 2013 to reflect vegetation changing activities (fire and harvest) that occurred between 2009 and 2013. R1 VMAP data is used in the Forest plan revision as a basis for the spatial representation and description of existing vegetation conditions and for the spatial modeling of vegetation conditions over time.

Unless indicated otherwise in this EIS, the source of data for quantification of existing vegetation conditions is the R1 Summary Database, produced from the Forest Inventory and Analysis (FIA) program, using the Hybrid 2011 FIA Analysis Dataset. FIA data used for the Forest was collected 1993 to 1994 (41 periodic plots) and 2003 to 2011 (357 annual plots), for a total of 398 plots. FIA is a national inventory of forest ecosystem data derived from field sample locations distributed systematically across the U.S., regardless of ownership or management emphasis (Bush et al. 2006). Data collection standards are strictly controlled and the sample design and data collection methods are scientifically designed and repeatable. FIA provides a statistically-sound representative sample designed to provide unbiased estimates of forest conditions at broad- and mid-levels. It is particularly valuable for monitoring changes in forest and vegetation conditions over time, as plots have been permanently established and are remeasured on a regular basis, currently every 10 years.

Quantification of existing vegetation composition (dominance types, species presence), forest size classes, forest density (canopy cover), old growth, snags and downed woody material current conditions were derived from the FIA Hybrid2011 dataset. FIA data is also used in the Forest plan revision to corroborate with VMAP data for vegetation modeling, and to develop growth and yield tables for the model outputs. It is also the primary data source used for monitoring and evaluation of vegetation conditions over time in the forest plan monitoring program.

The Forest Service Activity Tracking System (FACTS) is the source for information related to vegetation treatments (i.e., harvest, non-commercial thinning, planting, fuels reduction, invasive plant treatments, etc.) that have occurred on the forest in the past. FACTS stores information associated with the activities, such as methods used, surveys conducted, and acres treated. When linked to spatial data sets, these activities can be spatially displayed across the forest.

Analytical models were used to predict changes to vegetation over time and evaluate movement towards vegetation desired conditions. The Spectrum model was used to project alternative forest management scenerios, schedule vegetation treatments and provide outcomes, based upon a variety of input parameters, such as management objectives and budget limitations. The SIMPPLLE model (SIMulating Patterns and Processes at Landscape scaLEs) was used to simulate fire, insect and disease disturbances over time (historical and future), and the interaction of these disturbances with vegetative succession and treatment activities. The SIMPPLLE model provides for spatial analysis of future management activities as scheduled through the Spectrum model. Spectrum also is used to project timber harvest acres and volumes over time under different management scenarios. Appendix 2 describes the Spectrum analysis process in detail, and the resulting timber harvest outputs. Appendix 2 and the planning record contains more information on the use of the SIMPPLLE model to develop the natural range of variation and future projected vegetation conditions to support the development of forest plan components and analyze difference in alternatives within this EIS.

3.3.1 Methodology and analysis process

The analysis approach for the Forest plan revision is to maintain and/or restore the full spectrum of ecosystem biodiversity in the planning area. Biodiversity conservation focuses on the need to conserve dynamic, multi-scale ecological components, structures, and processes that sustain a full complement of native species and their supporting ecosystems. This general strategy is often called the “coarse filter” approach to ecosystem management. This terrestrial vegetation section of the EIS documents the coarse filter analysis of the terrestrial ecosystems on the Forest. Later sections focus on species-specific conditions and management strategies (for example section 3.5.1, Threatened, Endangered, Proposed and Candidate Plant Species), enabling a more “fine filter” analysis of elements of the ecosystem that are not adequately covered under this coarse filter approach.

Development of desired conditions

As required by planning regulations (36 CFR 219.1), forest plan direction must provide for ecological integrity while contributing to social and economic sustainability. Ecological integrity can be simply defined as the ability of the ecosystem to withstand and recover from most perturbations imposed by natural or human influences, and sustaining natural ecological processes and biodiversity into the future. In response to this direction, desired conditions for vegetation were developed for the key ecosystem components identified for the Flathead Forest. These desired conditions form the basis for comparison of alternatives.

Desired conditions describe specific ecological and vegetative conditions that portray the vision of what the Forest should look like in the future. They describe, to the best of our ability, what is desired for maintaining ecosystem integrity, while contributing to social and economic sustainability. Though the forest plan provides direction for management of the forest over a relatively short period of time (the next 15 years), desired conditions were developed with the long term view in mind as well. This is necessary because ecological, social and economic sustainability concepts require a long-term perspective for appropriate interpretation and evaluation.

To address the inherent uncertainty of future conditions, desired conditions incorporated strategies that would maintain or improve the resilience of forests and the ecosystem and promote the adaptability of vegetation. Development of desired conditions recognize and capitalize on the different adaptation and survival strategies trees and other plant species have in response to fire, drought, diseases, and other perturbations.

An analysis of the historical, or natural, range of variation (NRV) for key ecosystem components was the underlying element that informed the development of desired conditions for the revised forest plan. NRV provides insight and a frame of reference for evaluation of ecological integrity and resilience. It reflects the ecosystem conditions that have sustained the current complement of wildlife and plant species on the Forest, and provides context for understanding the natural diversity of the vegetation and what processes sustain vegetation productivity and diversity. Though humans have shaped the ecosystems of the Forest for thousands of years, since the mid-1800s human presence and activities have increased dramatically in the plan area, along with associated impacts to ecosystem conditions. NRV estimates provide a reference to conditions that might have occurred prior to this recent increase in human impacts.

Additional factors considered in the development of desired conditions included sustaining stand structures or species compositions that provide habitat for at-risk wildlife or plant species; conserving more rare structures or other ecosystem components on the landscape; existing or anticipated human use patterns or desires for specific vegetation conditions; consideration of the effect changing climate may have on vegetation; and the ecosystem services desired and expected from Forest lands (such as reduction of fire hazard and production of forest products).

More detailed documentation of development of NRV and desired conditions can be found in appendix 2 and in the planning record.

Discussion of modeling and evaluation of vegetation change

Vegetation across the forest will change over time, in response to both natural ecological disturbances (such as fire and insects), human elements (such as timber harvest and prescribed burning), and the interaction of these factors with vegetation succession and climate. The desired condition is to maintain vegetation conditions within the desired ranges over time to contribute to forest and ecosystem resilience. Simulation of potential vegetation change across five decades into the future was conducted. Fifty years is considered a reasonable time period over which to model potential disturbances and succession, and to capture trends in vegetation condition, considering that some drivers of change occur very quickly (such as fire), though others are much more gradual (such as vegetative succession). However, it should be noted that fifty years is also considered a relatively short time period to adequately portray some of the shifts in conditions that may occur for species that are as long-lived and persistent as the conifer trees. There is an increasing level of uncertainty associated with ecological and social change the farther into the future you go, especially as linked to climate change. Up to 30 model simulations were run to better capture the variability and uncertainties associated with disturbance events and resulting vegetation change. The model was run with a “normal” climate condition for the first two decades, and a “warmer” climate condition for decades three through five.

As discussed under the Information Sources section above, Spectrum and SIMPPLLE are the two analytical models used to evaluate vegetation conditions and changes over time. In the Spectrum model, vegetation management activities expected to occur over time in each alternative were formulated by considering the Management Areas, land suitability, other resource limitations on treatments (such as within Canada lynx habitat, or grizzly bear security core) and budget limitations. For each of the alternatives, the Spectrum model was run with an objective that was in keeping with the theme of the alternative. For alternatives B and C, the objective was to maintain or trend towards the desired conditions for vegetation composition (dominance types) and structure (forest size classes). For alternative D, the objective was to maximize timber in the first decade and then maintain or trend towards vegetation desired conditions for the succeeding four decades. For alternative A the model was run with an objective to maximize timber production over all five decades, because there are no quantitative desired conditions for vegetation in the existing forest plan. The timber product outputs resulting from the Spectrum model analysis are displayed and compared in the Timber section of this EIS, with the analysis process described in detail in appendix 2 of this EIS.

The treatment acres (harvest and prescribed fire) resulting from the Spectrum model are not spatially explicit. Projected treatments were integrated into the SIMPPLLE model to allow for a spatial analysis of vegetation change over time, and to interact with vegetation succession pathways, and the fire, insect and disease assumptions within the SIMPPLLE model. The attributes modeled quantitatively for the analysis of vegetation changes over time include vegetation composition, forest size classes and forest density (canopy cover). All model outputs assume a reasonably foreseeable future budget, similar to current budgets.

It is important to understand the strengths and limitations of the analytical models to appropriately interpret the results. Out of necessity, the models simplify a very complex and dynamic relationship between ecosystem processes and drivers (such as climate, fire and succession) and vegetation, over time and space. The models use a given set of assumptions, including the amount of stand-replacing fire, insect or disease activity, and the rate of tree growth and stand structure change over time (succession). These assumptions are based on analysis and corroboration of actual data (such as fire history and historical vegetation information) and review of scientific literature, as well as professional judgement and experience of resource specialists familiar with the ecosystems and forest types of the Flathead. Though best available information and knowledge is used to build these models, there is a high degree of variability and uncertainty associated with the results because of the ecological complexity and inability to accurately predict timing/location of future events. Timing, magnitude and/or location of disturbances, such as fire or bark beetle activity, may differ from that modeled, resulting in different effects to vegetation. In addition, the task of modeling potential treatments, accurately representing the impacts of numerous limitations on treatments (i.e., lynx habitat, grizzly bear security), and then integrating these treatments with multiple ecological processes and disturbances is very complex. Up to 30 model simulations were run to better capture some of this variability associated with disturbance events and resulting vegetation change.

Model results are not objectives for plan implementation but merely a useful indicator of how vegetation may change over time. Models are but one tool to help inform the analysis of effects in this EIS, useful for understanding relative differences between alternatives and general trends in vegetation. These models are for comparative value, and are not intended to be predictive or to produce precise values for vegetation conditions. Model outputs augment other sources of information, including research and professional knowledge of how ecosystem processes (such as succession) and disturbances/stressors (such as fire, insect, harvest, and climate) might influence changes in vegetation conditions over time, especially at the scale of the planning unit. All these sources of information are used in the evaluation of environmental consequences of alternatives.

Appendix 2 and exhibits in the planning record provide additional and more comprehensive information and discussion of the process and quantitative results of the modeled vegetation changes over the five decade modeling period. Key results from modeling are summarized in this EIS where central to the discussion of environmental consequence and comparison of alternatives.

Biophysical settings and analysis scale

Terrestrial vegetation characteristics in this EIS are described across Flathead National Forest lands at two geographical scales: forest-wide and, for some characteristics, by biophysical settings. Biophysical settings identify sites of similar environmental conditions and provides the basis for our understanding and description of the Forest ecosystems. They provide information on the inherent capability of the land to support certain types of vegetative communities and the nature of change in those plant communities over time through succession and in response to disturbances. The discussion that follows describes the development of biophysical settings and their distribution across the Forest. Refer also to appendix D of the revised plan.

Biophysical settings are groupings of potential vegetation types (PVTs); PVTs are groupings of habitat types. Habitat types are a classification of sites based on physical and environmental similarities, which result in similar potential plant communities (e.g., climax plant communities) and ecological processes (such as succession).

The designation of habitat types is based on the potential climax plant community that would occur on the site (Pfister et al 1977). Climax conditions represent the culmination of the plant community conditions that would occur through natural succession in the absence of stand replacing disturbances (such as fire). Though the general characteristics of the climax plant community may be the same on sites of the same habitat type, at any one point in time the existing plant communities and conditions on areas of the same habitat type could be very different. Conditions would vary due to factors unique to each site, such as the disturbance history, pattern and frequency, and its influence on tree regeneration, species, density and other characteristics. Habitat typing is a fine-scale classification of lands, and there are nearly 50 forest habitat types present on the Flathead Forest.

PVTs are groupings of habitat types into areas of similar climate, slope, soils, and other biophysical characteristics. The baseline PVT classification used on the Forest is the Region 1 PVT Classification for western Montana and northern Idaho (USDA 2004). This layer provides a consistently derived and contiguous mapping of potential vegetation types across the Region. The mapping was completed by the Northern Region Forest Service in 2004, using as data sources field plots, remote sensing, modeling and extrapolation of plot data. Though this PVT map represent a broad grouping of habitat types, it is still a relatively fine-scale land classification. There are eighteen forested PVTs and seven grass/shrub/hardwood PVTs observed on the Forest.

Biophysical settings are groupings of PVTs based on similarities of climatic and physical factors, for purposes of analysis at the broad forest wide scale and for development of forest plan components. Groupings of PVTs for the Flathead are consistent with the R1 Broad PVT groupings (Milburn et al 2015) and applicable for broad level analysis and monitoring. Four coniferous biophysical settings and two non-coniferous biophysical settings have been identified for the Forest, and serve as the basis for description and analysis of certain ecological conditions at the forest-wide scale. Areas within each of the biophysical settings would have similarities in patterns of potential natural plant communities, potential productivity, natural biodiversity, and the types of ecological processes that sustain these conditions.

Table 9 provides the acres and proportion of each biophysical setting within the geographic areas (GAs) on the Forest. Appendix D of the forest plan provides a table displaying the grouping of habitat types and PVTs into the biophysical settings. Appendix B contains maps displaying biophysical settings forest-wide and for each geographic area.

Table 9. Percent and acres[a] of each biophysical setting on National Forest lands forestwide and within each geographic area (GA)

Biophysical setting	Hungry Horse GA	Middle Fork GA	North Fork GA	Salish Mtn GA	South Fork GA	Swan Valley GA	Total percent & acres Forestwide
Warm-Dry	5% 13,200	5% 17,600	2% 6,200	18% 48,400	14% 109,100	8% 28,000	9% 222,500
Warm-Moist	2% 6,200	<1% 800	4% 13,000	5% 13,000	<1% 600	20% 72,700	4% 106,300
Cool-Moist/ Moderately Dry	85% 242,800	75% 275,300	72% 228,100	76% 198,900	58% 459,700	57% 207,300	68% 1,612,100

Biophysical setting	Hungry Horse GA	Middle Fork GA	North Fork GA	Salish Mtn GA	South Fork GA	Swan Valley GA	Total percent & acres Forestwide
Cold	6% 17,100	14% 53,000	21% 67,400	1% 1,800	21% 163,700	9% 32,500	14% 335,500
Non-forest vegetation types (grass/forb/shrub hardwood, non-forest)	2% 5,900	6% 21.900	1% 4.300	<1% 300	7% 54.300	6% 22,000	5% 108,700
Total acres[a]	285,200	368,600	319,000	262,400	787,400	362,500	2,385,200

a. All acreages in the table are estimates and rounded to nearest 100 acres. Water is excluded. Data source: FNF GIS Library, R1 VMap layer (2009, updated through 2012 for changes due to disturbances), and joined with potential vegetation types GIS layer (USDA 2004).

The warm-dry biophysical setting occupies the warmest and driest sites on the Forest that support forest vegetation. All sites supporting ponderosa pine and Douglas-fir climax forest communities fall within this setting, as well as the driest of the grand fir habitat types. Douglas-fir habitat types dominate by far, covering over 90% of the lands within this biophysical setting. The warm dry setting mainly occurs at the lower elevations or warmer southerly aspects across the forest, or on droughty soils.

The warm-moist biophysical setting includes moist sites that are relatively warm, largely limited to lower elevation sites and wider valley bottoms with relatively productive, deep soils. All western redcedar and western hemlock habitat types are within this setting, as well as the moist grand fir habitat types. The majority of this setting occurs within the Swan Valley geographic area.

The cool-moist/moderately dry biophysical setting comprises the majority of the lands on the Forest, well distributed across all geographic areas. Subalpine fir habitat types dominate by far, comprising over 95% of the lands in this setting. Spruce habitat types make up most of the remainder. This setting occurs on low to mid elevation sites across all aspects. Most sites fall within the moist end of the spectrum (about 75%), with the moderately dry sites limited largely to southerly or westerly aspects dispersed within the larger matrix of moist areas.

The cold biophysical setting occupies the higher elevation areas on the Forest. Most sites are cold, moist subalpine fir habitat types that support moderately dense forest cover. Remaining areas are cold, drier subalpine fir and whitebark pine types where growing conditions are harsher and tree density more open.

Non-forest biophysical settings consist of the persistent non-coniferous vegetation types and areas of very sparse or no vegetation, such as scree or barren areas. For purposes of this analysis, persistent hardwood tree and grass/forb/shrub communities are defined as dominating the site for at least a 50-year period. They occur on sites where establishment and growth of conifers is severely impeded, for example in areas of shallow or very droughty soils; very wet soils and high water tables; or very frequent disturbance, such as by avalanche or flood. The persistent grass/forb/shrub types range from alpine meadows to dry grassland types to moist shrub dominated riparian areas. Persistent hardwood types are mainly cottonwood groves in floodplains and areas of high water tables.

Incomplete and unavailable information

Terrestrial ecosystems are highly complex and contain an enormous number of known and unknown living and non-living factors that interact with each other, often in unpredictable ways. For this reason, we acknowledge that there are gaps in available information and knowledge about ecological functioning, and an inability to even evaluate what those gaps may be. This gap in our information may lessen over time as new information or methodology is devised.

Vegetation is very dynamic, changing constantly due to succession and in response to disturbances and stressors. Our descriptions of vegetation represent only one point in time. Our ability to predict changes in vegetation into the future is limited, and is subject to uncertainty. The level of uncertainty depends on how predictable such factors as natural disturbances, climate change, or human caused disturbances may be.

Analysis area

The affected area for effects to terrestrial vegetation is the lands administered by the Forest. This area represents the NFS lands where changes may occur to vegetation as a result of management activities or natural events.

The affected area for cumulative effects to terrestrial vegetation includes the lands administered by the Forest, as well as the lands of other ownership, both within and immediately adjacent to the Forest boundaries.

3.3.2 Vegetation affected environment and environmental consequences

Introduction

A primary goal of forest plan direction related to the vegetation component is to provide for ecological integrity and sustainability, supporting a full suite of native plant and animal species, while providing for the social and economic needs of human communities. Resistance and resilience of vegetation are important concepts as they relate to integrity and sustainability of the ecosystem in the face of future uncertainties. Resistance refers to the capacity of ecosystems to tolerate disturbances without exhibiting significant change in structure and composition. Resilience refers to the ability of a system to recover from disturbance in the event that the disturbance exceeds the capacity of the system to resist changing (Holling 1973). Hereafter in this document, the concepts of resistance and resilience will be jointly referred to as “resilience”.

Ecosystem integrity as related to vegetation is typically assessed by considering dominant ecosystem functions, composition, structure and connectivity. The key ecosystem characteristics listed earlier are the identified indicators that will be used to describe ecosystem conditions and integrity, and, considered as a whole, provide a means to address forest resilience and compare effects between alternatives. The desired conditions for the vegetation component (see section 3.3.1 Methodology and Analysis Process) and its relationship to the current and potential future conditions upon implementation of forest plan direction form the basis for the evaluation of environmental consequences and comparison of alternatives in this section.

This section begins by describing the primary ecosystem processes and disturbances (e.g., the dominant ecosystem functions) that affect vegetation composition and structure. Composition can be described as the types and variety of the vegetation, which in the case of the Flathead Forest is overwhelmingly dominated by coniferous forest types. Structure can be described as the physical form of the forest stand, i.e. the vertical and horizontal arrangement of plants, dead and alive. Forest structure is a complex construct, which may include number of tree canopy layers, tree density, dead wood components, and tree sizes. At the forest-wide scale of this analysis consideration of forest structure is necessarily coarse. Indicators of forest structural diversity across the forest landscape analyzed in this EIS are forest size class, very large live trees, snags and downed wood, old growth structures and forest density.

The remainder of this chapter describes the affected environment and the environmental consequences of the alternatives for each key vegetation indicator. The environmental consequence section includes a summary and comparison of model results for certain indicators, disclosing trends or future conditions that are considered important and relevant to the comparison of alternatives. Documentation of the modeling process, and detailed tables and figures displaying outputs over time are found in appendix 2 and in exhibits within the planning record.

Summary of ecosystem processes and disturbances

The vegetation conditions on the forest are not static, but are constantly changing across space and time. The primary causes of vegetation change that are integrated into this analysis are climate, vegetation succession, fire, forest insects and diseases, and treatments (i.e. timber harvest). The complex interactions between these ecosystem processes and disturbances over past centuries have resulted in the vegetation composition and structure that currently exists, and that will be responsible for the changes to vegetation into the future evaluated in this EIS. Each is briefly discussed below. Additional detail can be found in the Assessment.

Climate

Climate strongly influences vegetation conditions and ecosystem processes. Temperature and moisture patterns will dictate what trees and other plant species are able to establish and grow on a site, as well as such factors as growth rates and plant density. Periodic drought can alter forest conditions through direct mortality of trees, or indirectly, such as by increasing the frequency and/or severity of fire, or rendering trees more susceptible to insect and disease mortality.

Considerable natural variation in climate conditions has occurred historically, both over the long time frame (e.g., many centuries) and shorter time frame (e.g., the past 100 to 200 years). The future climate change projections summarized in the introduction to chapter 3 of this EIS, and in the FNF Assessment suggest that temperature increases in future decades will exceed the historical variation and average monthly maximum temperature. Specific changes in ecosystem components due to expected climate change are difficult to predict, and are highly uncertain, especially in the mountainous, diverse terrain of the northern Rocky Mountain region. Given the high uncertainties, it is the conclusion of the authors of the NRAP climate change assessment for vegetation (Keane et al 2015), that “assessing vegetation change and vulnerabilities is currently more of an educated guess based on inconsistent and contradictory studies rather than a highly confident evaluation of comprehensive scientific investigation.” Therefore, taking a relatively broad approach to management of the ecosystems of the Flathead is prudent, focusing on strategies that increase the overall resilience of the forests to allow adaption to whatever changes the future may bring. This translates to concepts that include maintaining or increasing biodiversity (species, forest structures, pattern complexity, etc.), featuring species and forest conditions that are more resistant and resilient to fire and insect/disease, and maintaining healthy, vigorous forest conditions. The revised forest plan has taken this approach to addressing potential climate change and associated change in ecosystem function in development of management direction for vegetation.

Some possible effects to vegetation from increasing temperatures are as follows. For the forests of the western U.S., it is likely that water balance and disturbance dynamics will be more important than actual increased temperature in affecting vegetation conditions. Longer, warmer growing seasons may increase growth rates; however, greater soil water deficits and increased evapotranspiration in the summer may offset this effect and increase plant stress. This latter result is more likely on the Forest, where water is currently a limiting factor on many sites. Stress can lead to higher mortality rates, either directly caused by water stress or indirectly by insects or disease. Increasing soil water deficits can also cause eventual shifts in species presence across the landscape as they become less able to successfully regenerate or survive under changing site conditions. Species located on sites at the margin of their optimal range would be most vulnerable, such as ponderosa pine on the driest sites, western larch on south aspects, whitebark pine in mid-elevations, and western white pine on the drier sites.

Because of changing water balances, climate changes are expected to affect disturbance processes within forested ecosystems of the western U.S. On the Flathead, fire, insects and disease would potentially experience the most notable changes. There is a high degree of variability and uncertainties associated with extrapolation of these kinds of effects to more local sites, such as the Forest. As summarized in NRAP report (2015, chapter 8, references incorporated), studies of potential effects of climate change on fire and insect/disease suggest the following may occur across the western US and Canada (refer also to fire and fuels section of this EIS):

- Related to wildfire: Longer fire seasons, more days of high fire danger, increased frequency of ignitions, more frequent large fires, more episodes of extreme fire behavior, and increased average annual area burned.
- Related to insect and disease: Given availability and spatial distribution of host species, there may be elevated levels of native insects and disease, with bark beetles (mountain pine beetle, Douglas-fir beetle) and western spruce budworm notable examples for the Flathead. These increases are closely tied to increased stress of trees due to changing water balances. Climate changes on forest diseases are difficult to predict, but predicted increases in temperature and drought will probably serve to increase pathogen populations in the future. The roles of pathogens as important disturbance agents will likely increase in the future because they are able to migrate to new environments at a faster rate than trees.

Vegetative Succession

Vegetative succession is the sequential process of long-term plant community change and development. Succession entails the change in the composition, structure and function of plant communities over time following a disturbance (such as fire), and is based on the concept that every plant species has a particular set of environmental conditions under which it will reproduce and grow optimally. Successional pathways are complex and varied, reflecting the tangled web in inter-relationships between site conditions, vegetation and multiple ecosystem processes and disturbances, as well as weather and climate. The rate of successional change can also be highly variable.

Simplification of the complex successional process for integration at the scale of this forest-wide analysis is necessary. For purposes of the analysis for this DEIS, evaluation of forest size classes (see descriptions of forest size classes in section 3.2.5) provide the means to evaluate successional change of forests over time and their contribution to the biodiversity across the forest. The early successional stage is characterized by the seedling/sapling forest size class. This successional stage creates a forest opening, because the much shorter trees and other vegetation create a distinct boundary and noticeably different condition to adjacent stands that are dominated by larger trees. As trees grow, they would be expected to transition through vegetative succession from smaller size classes into larger size classes. Mid-successional forests are associated primarily with the small and medium forest size classes, but in some cases forests in the large size class would also be considered mid-successional,, depending on tree ages and species. Late successional forests are associated mainly with the very large forest size class, though stands in the large size class may be late successional, again depending on tree ages and species.

Wildfire

Fire is a primary ecological process that has created, maintained and renewed the diversity of forests and vegetation in the Flathead Forest ecosystems, which in turn sustains the associated plant and animal species. The current vegetation conditions have resulted from past disturbances, where fire was a prevailing feature.

Fire regimes (e.g., frequency, size, severity, pattern of fires) on the Flathead are described in detail in the Assessment. Historical fire patterns are described in the Fire and Fuels section of this EIS, and are briefly summarized here. The most common fire regimes on the Forest feature moderate and high severity fire, where most or all trees are killed across both small (e.g., less than 100 acres) and very large (e.g., tens of thousands of acres) areas. Climatic conditions feature largely in both the size, extent, and severity of fires. Historically, extended periods of warm and/or dry climatic conditions tended to be associated with larger, higher severity and more widespread fire events. Periods of more cool and/or moist climatic conditions tended to be associated with smaller and less severe fires. Long time intervals (e.g., 100 years or more) between major fire events in a particular area were common, particularly during cool and/or moist climatic periods. These long time periods allowed forest lands to once again develop into the mid and later stages of succession, including old growth. Wildfire is typically a very dramatic event, and in a matter of hours thousands of acres of mid or late successional forest can be converted to an open, early successional forest.

Fire on the landscape comes from natural ignitions and human caused starts. Fire management strategies recognize the important ecological role of fire. Wildfire suppression strategies consider such factors as fire location, time of season, fuel conditions, and resource availability. Wildfires on the Flathead Forest started by any source that threatens identified values are suppressed as soon as possible.

Use of wildfire to deliberately achieve desired vegetation objectives is a management action that may be used, particularly within wilderness. Within wilderness areas, wildfire is allowed to occur as a natural disturbance process. From 2001 to 2013, approximately 131,900 acres of wildland fire use occurred on the Forest, all within wilderness areas. These wildfires are largely higher severity stand replacement burns, creating large areas of early successional forest openings. Some areas burn at more moderate severity, where 40 to 70% of the trees survive the fire.

Refer to fire and fuels management section 3.8 for additional information on fire.

Forest insects and diseases

There are many insects and diseases that affect vegetation in the forests of the Forest. Most are native and usually exist at relatively low population or intensity levels that do not cause notable large scale or long term impacts to forests. The actions of insects and disease are natural ecological processes that have played a major role in the past and will continue into the future as a driver of vegetative change. Effects may be rather dramatic, such as when epidemic conditions for mountain pine beetle causes high mortality over the span of one year in lodgepole pine forests. More often, effects due to insects and disease occur more gradually, but still can cause major changes to vegetation conditions. In the absence of fire, insects and diseases account for an estimated 75% of change in vegetation over time (Hagle and Byler 2000).

Insects and diseases that are considered to have the most notable impacts on forest conditions at the landscape scale and/or over time are included in this analysis, and briefly summarized in this section. Refer to the assessment for additional information. There may be other insects or diseases that become more important in the future relative to impacts on forest conditions if warming climatic conditions occur, especially with an increase in disturbances such as fire.

Mountain pine beetle

Mountain pine beetle is the most aggressive and persistent bark beetle. Host species are lodgepole pine, ponderosa pine, western white pine and whitebark pine. Lodgepole pine is its most abundant and widespread host species, and tends to grow in large, often nearly pure stands of similar size trees. This contributes to epidemic population levels of MPB periodically developing across this ecosystem, killing large numbers of lodgepole as well as spreading into the surrounding areas and killing trees of other pine species. Generally, the larger the tree diameter the more susceptible it is to mountain pine beetle attack. During an infestation, all or nearly all trees can be killed in some susceptible stands over a relatively short time period (e.g., a few years), opening forest canopies enough to return them to the early stage of succession, providing regeneration opportunities for shade intolerant tree species. They also commonly allow the growth release of understory shade-tolerant tree species that are already present on the site. Tree mortality also increases the amount of snags and dead, down woody material. This can influence the probability of large stand-replacing fires, which in turn can return the stand to the early successional stage.

Figure 10 displays mountain pine beetle hazard (primarily for lodgepole pine) across the Forest. Hazard is defined as the likelihood of an outbreak within a specific time period and is a function of forest conditions and susceptibility to mountain pine beetle. Elevation, age, size and proportion/density of lodgepole pine are factors used in the hazard rating. The majority (more than 80%) of the acres at low, moderate or high hazard lies within the cool moist-moderately dry biophysical setting.

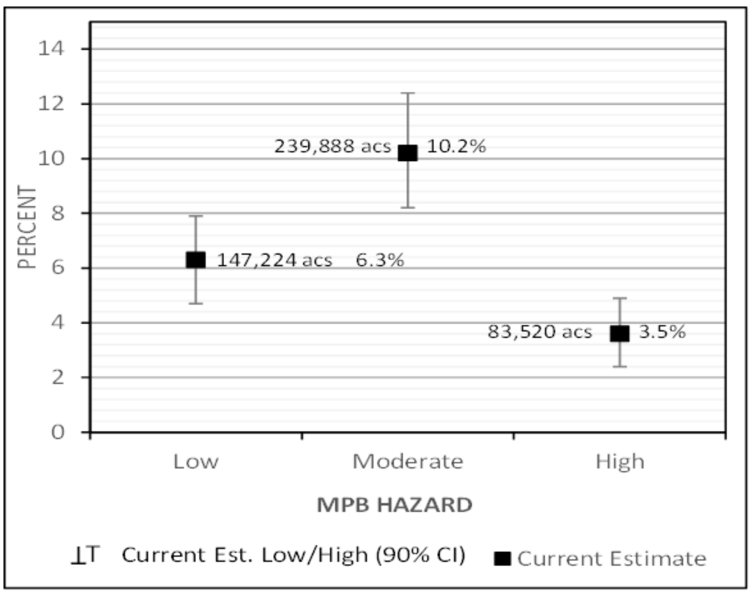


Figure 10. Percent and acres of high, moderate and low hazard for mountain pine beetle in lodgepole pine, forestwide.

Data source: FIA data using R1 Summary database (Hybrid 2011) analysis tools.

Recent review of aerial detection survey data indicates that mountain pine beetle was present every year on the Flathead at mostly elevated levels during the 36 year time period from 1979 to 2015. Acres of tree mortality attributed to mountain pine beetle ranged between 100 and 308,00 acres. The average was 66,408 acres. The most recent outbreak began in 2002, when beetle populations began to build and MPB mortality of mostly lodgepole noted on about 21,000 acres across the forest. Between 2002 and 2010, from 22,000 to 78,000 acres each year on the forest have experienced notable levels of mortality from MPB, peaking in 2010. Beetle populations subsided in 2012, with fewer than 7000 acres of mortality across the forest, dropping to approximately 2,000 acres in 2013.

As summarized in chapter 8 of the NRAP report (2015 draft, references incorporated), potential climate changes in the future are likely to have an affect on bark beetle activity. Many bark beetle life history traits that influence beetle population success are temperature dependent. Stress of host trees due to changing water balance increases vulnerability of trees to bark beetle attack and mortality. Warming temperatures associated with climate change have directly influenced bark beetle-caused mortality in some areas of western North America. Future bark beetle-caused mortality will depend not only on the spatial distribution of host trees and pattern across the landscape, but also the ability and capability of beetle populations to adapt to changing conditions. Beetle populations may be favored by warming temperatures, due to potential for increased survival of beetles, and to increased stress of the host species.

Douglas-fir beetle

Douglas-fir is one of the most dominant and widespread species on the forest, and Douglas-fir beetle is a chronic mortality agent within Douglas-fir stands, killing or injuring individuals and small groups of Douglas-fir across the forest every year. Beetle outbreaks and widespread mortality of trees occur periodically in this ecosystem, typically following stand disturbances, such as fire, severe drought and windthrow, where large areas of weakened trees exist. Persistent root disease provides habitat for the maintenance of endemic levels of Douglas-fir bark beetle. Larger diameter trees (e.g., greater than 15 inches d.b.h.) are most vulnerable to beetle attack. Figure 11 displays estimated Douglas-fir beetle hazard across the forest. Though most of these low, moderate and high hazard acres occur on the cool moist-moderately dry biophysical setting, a disproportionate amount of the forests within the warm dry and warm moist settings have hazard to Douglas-fir beetle. Low, moderate or high hazard Douglas-fir beetle forests occur across an estimated 119,000 acres, or 55% of the warm dry setting, and an estimated 69,237 acres, or 65% of the warm moist setting.

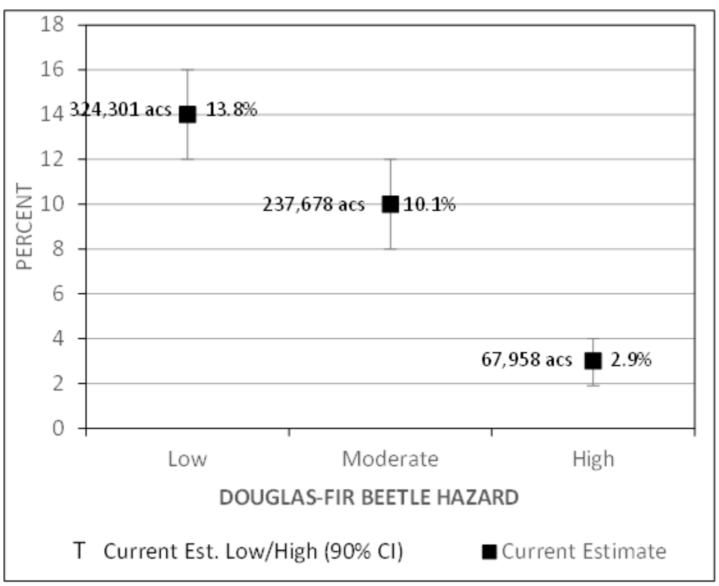


Figure 11. Percent and acres of high, moderate, and low hazard for Douglas-fir beetle, forestwide.
Data source: FIA data using R1 Summary database (Hybrid 2011) analysis tools.

Recent review of aerial detection survey data indicates that Douglas-fir beetle was present every year on the Flathead at some level during the 36 year time period from 1979 to 2015. Acres of tree mortality attributed to Douglas-fir beetle ranged between three and 14,000. The average was 2,873 acres per year.

Douglas-fir beetle activity would likely be influenced by expected warming future climate in similar ways as mountain pine beetle. Not only would beetle survival be enhanced by warming temperature, stress levels of host species would make them more vulnerable to beetle attack.

Spruce beetle

Spruce beetle is the most significant natural mortality agent of mature spruce, and its host on the Flathead is Engelmann spruce. Outbreaks of this beetle have caused extensive spruce mortality from Alaska to Arizona and have occurred in every forest with substantial spruce stands. Spruce beetle outbreaks cause extensive tree mortality and modify stand structure by reducing the average tree diameter, height, and stand density. Residual trees are often slow-growing small and intermediate-sized trees which eventually become dominant.

Endemic spruce beetle populations usually live in windthrown trees, and most outbreaks in standing trees originate in windthrown trees. When populations increase to high levels in downed trees, beetles may enter susceptible, large-diameter standing trees. Spruce beetle also attacks trees that are weakened by fire, root disease or other stress agents. Beetle outbreaks can occur following stand disturbances, such as fire or widespread blowdown of trees after a high wind event.

As with Douglas-fir beetle, larger diameter trees are more susceptible to beetle attack. In the Rocky Mountain area, susceptibility, or hazard, of a stand to spruce beetle attack is based on the physiographic location, tree diameter, basal area, and percentage of spruce in the canopy. Spruce stands are highly susceptible if they grow on well-drained sites in creek bottoms, have an average d.b.h. of 16 inches or more, have a basal area greater than 150 square feet per acre, and have more than 65 percent spruce in the canopy.

Spruce beetle is currently at endemic levels on the Forest primarily due to the lack of widespread availability of stands containing larger spruce. Areas where large diameter spruce dominated forests develop are commonly associated with the moist areas and riparian zones, which tend to form relatively narrow linear or discontinuous pattern across the landscape. Large outbreaks of spruce beetle in the 1950s and 1960s resulted in high mortality of large diameter spruce in portions of the forest. This event, and subsequent salvage/sanitation harvesting, removed many larger diameter spruce, and the current forest in these areas are yet young and not susceptible to spruce beetle.

Western spruce budworm

This is a widely distributed native insect that historically has caused widespread damage and tree mortality of drier forests east of the Continental Divide. It is a defoliator, feeding on the flowers, cones and foliage of trees. The most common and severely affected host trees on the Flathead are Douglas-fir, subalpine fir, grand fir, and Engelmann spruce. Damage includes top-killing of the trees, severe growth reduction, and some tree mortality mostly in sapling sized and smaller trees. Newly established seedlings are particularly vulnerable to being seriously damaged or killed by larvae. Seedling damage or mortality, coupled with the impact of larvae feeding on seeds and cones, can significantly delay the establishment of natural regeneration of host-tree species. Young trees are particularly vulnerable when growing beneath a canopy of overstory trees, where larvae falling from the overstory canopy layers find abundant food source in the understory trees. In mature stands, trees severely defoliated by the western spruce budworm may be predisposed to one or more species of tree-killing bark beetles, mainly the Douglas-fir beetle and the fir engraver beetle.

Outbreaks of spruce budworm often follow periods of drought. Similarly to bark beetles, warmer climatic conditions tend to provide favorable conditions for budworm, especially if it is associated with increased stress in the host species. There is an ongoing outbreak of the western spruce budworm in the northern

Rocky Mountains that began in 2008 and is still continuing into 2015. Aerial detection surveys recorded 375,000 acres defoliated in 2014. Over the past 70 years, the Forest has experienced four major budworm outbreaks, including the current outbreak. Outbreaks appear to be very cyclical. During an outbreak in the early 1970s, number of acres defoliated by budworm peaked at 383,500 in 1972. There was a 15-year break from budworm defoliation on the Flathead and most of the other national forests between 1993 and 2009. The only other sustained period of time where budworm was non-existent on the forest was from 1959 to 1966.

Root disease

Root diseases are the most damaging group of tree diseases (Hagle 2004). Root diseases are caused by fungi that spread from the roots of diseased trees to those of healthy ones. Root disease fungi are widely distributed across the forested sites of the Forest. The main root pathogens known to occur on the Forest include Heterobasidion root disease, armillaria root disease, tomentosus root disease, and schweinitzii root and butt rot. All tree species on the Forest are affected by one or more of these fungal diseases, with varying degrees of tolerance among tree species and differing intensity of infection among sites. Douglas-fir, subalpine fir and grand fir tend to be the most susceptible to these pathogens; ponderosa pine and western larch the least susceptible.

At high infection levels, in trees stressed by other factors, or over time itself, these root diseases are capable of killing trees outright. Other stress or mortality agents, such as bark beetles, drought, or windthrow, often contribute either directly or indirectly to the death of trees. Sometimes large numbers of trees in an area may be killed within a period of a few years, but in most cases root diseases will kill individuals and groups (large or small) of trees more gradually over time. As such they usually act as thinning agents in the forest, killing the more root disease-susceptible individuals and species. This would favor more resistant species, with the potential to cause major shifts in species composition and changes in forest structure over time. Once established on a site, root disease fungi can be persistent to essentially permanent, living for decades in the roots and stumps and killing new trees that seed into the site (Hagle 2006).

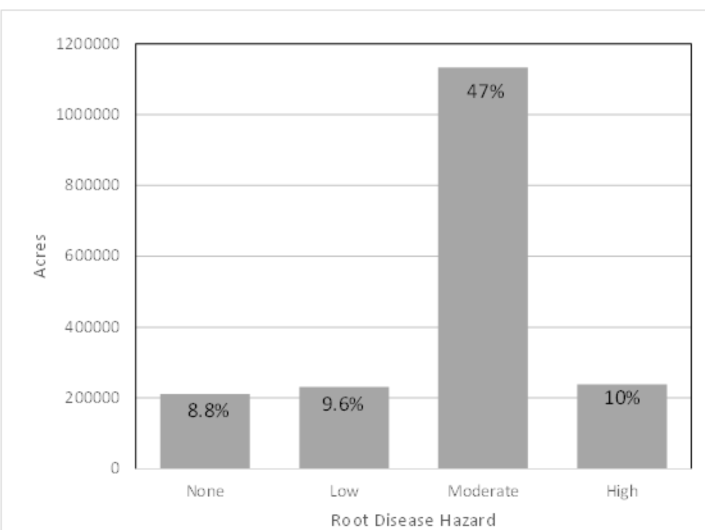


Figure 12. Acres of high, moderate, low and no hazard for root disease for the Forest.
Source: VMap.

Root disease hazard ratings of low, moderate or high indicates the degree of probability that root diseases exist on the site, and the impacts to susceptible species that might occur. Ratings use a combination of site conditions (e.g., potential vegetation types) and dominant species. The hazard rating for lands across the Forest is in Figure 12.

Nearly 70% of the Forest has some level of hazard to root disease. The highest hazard on the Flathead Forest occurs on grand fir, subalpine fir, Douglas-fir, and western redcedar potential vegetation types, and this level of hazard reflects the high proportion of the forest where subalpine fir is dominant (both as a potential vegetation type and as a forest dominance type). Although not all acres within the high hazard class have root disease, this class has the greatest potential for severe root disease to occur on the ground and significant impacts where it does occur.

Root disease severity indicates the acres where root disease is actually present at some level across the forest. Figure 13 displays the acres of root disease severity on the Flathead.

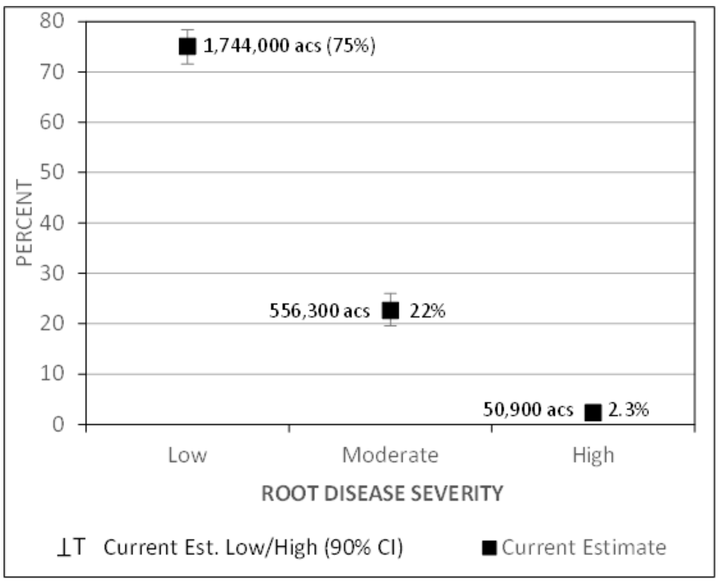


Figure 13. Acres of high, moderate, and low severity for root disease across the Forest.
Data source: FIA data using R1 Summary database (Hybrid 2011) analysis tools.

Not only is there a high level of root disease hazard across the forest, but most of these acres appear to have root disease present, though mostly at low levels. Root disease expresses itself in a variety of ways, depending on the pathogen species and degree of infection, and on forest conditions. It may affect patches of trees or individuals. It usually weakens and kills trees gradually over a period of years or decades, with secondary agents (such as bark beetles) often striking the final blow to the weakened tree. Once established, root disease pathogens persist for decades in the roots of stumps and dead trees. The pathogen is not eliminated by fire, and can infect newly regenerated trees of the host species if present.

Root disease and other pathogens commonly respond to weakened or less vigorous host tree conditions, so their importance could increase if climatic conditions less favorable to tree growth become more frequent in the future.

White pine blister rust

Unlike the other insects and diseases discussed above, white pine blister rust is a non-native, introduced disease, entering the U.S. from Europe at the turn of the 20th century. It infects all five-needled pines, and its primary host species on the Forest are western white pine and whitebark pine. The pathogen kills trees of all ages and sizes. It also infects leaves of Ribes species (currants and gooseberries), which are alternative hosts that are required for blister rust to complete its life cycle. Other possible, but as yet undetermined, alternative species include louseworts and Indian paintbrush. .

Both western white pine and whitebark pine are important contributors to the ecosystem diversity, structure, and resiliency of forests in the planning area. Both are very long-lived species and well adapted to both survive and regenerate in the mixed and stand-replacement historical fire regimes of this ecosystem. However, they have little natural resistance to this introduced disease, and vast numbers of western white pine and whitebark pine trees have been killed across their ranges, which includes the Forest. The loss of these species have impacted forest resiliency in the face of potential future disturbances and wildlife habitat values. Refer to the section on Vegetation Composition in this EIS for further discussion of the existing condition of western white pine and whitebark pine, and the effects of this exotic disease on these species.

Vegetation treatments

Two broad categories of active vegetation treatments are evaluated in this EIS: timber harvest and prescribed fire. These treatments change forest conditions in both the short (i.e., one year) and long term. Timber harvest removes commercial timber products, and consists of three general types: even-aged regeneration, group selection and commercial thinning. Timber harvest prescriptions in this analysis also incorporate non-commercial thinning of young sapling stands and tree planting, both key treatments that influence stand composition and structure in the short and long term. Prescribed fires are planned ignitions, where fire is deliberately applied to the landscape. For purposes of this analysis, it refers to planned ignitions that are not associated with timber harvest areas (i.e., it does not include burning of harvest slash). Each of these treatments, how they may affect vegetation conditions, and a summary of past acres of treatments across the forest follows. Refer also to the Assessment for more detailed information.

Regeneration harvest (even-aged)

Regeneration harvest includes clearcuts, seedtree and shelterwood cuts with reserves, all of which remove the majority of the trees, opening up the forest canopy sufficiently to allow new tree seedlings to establish and grow. Forest size class changes to seedling/sapling, an early successional forest condition. Forest dominance types and species presence may also change, depending upon the composition of the regenerated forest. Forest densities and forest fuels (i.e., downed wood, snags) may change, either reduced or increased depending upon the pre-harvest forest conditions.

Non-commercial thinning (sometimes called pre-commercial thinning) is not directly modeled and analyzed in this EIS, but is incorporated into the even-aged regeneration harvest prescriptions. This thinning occurs in stand of sapling size (1 to 5 inches d.b.h.), and reduces tree densities. Species compositions may change by targeting different species for leaving or removing. Maintenance or improvement of tree growth may occur. Forest structure may be affected over the long term (e.g. tree sizes, forest density).

Similar to non-commercial thinning, tree planting is also incorporated into the even-aged regeneration harvest prescriptions. Tree planting primarily influences species compositions and in some situations forest density.

Group selection

Group selection harvest is a type of uneven-aged regeneration harvest, converting the forest to a seedling/sapling size class and potentially changing species composition. However, this conversion occurs gradually over a period of many decades, creating a multi-age and multi-size stand. Openings are created (i.e., typically less than one or two acres) over a portion of the stand in each harvest entry. For example, a particular stand may have a treatment entry every 10 to 15 years, treating 20% of the stand each entry by creating small openings, resulting in the entire stand being treated over a 50 to 75 year period.

Commercial thin

Commercial thinning removes fewer trees than in a regeneration harvest, leaving a forest that is less densely stocked but still dominated by trees larger than seedling/sapling size class. The focus is not on regenerating a new forest stand, but in changing the condition of the current one. Not only is forest density reduced, but species compositions and forest size class may change by unequal removal of trees of different species or size. Tree growth is typically accelerated. Reduction of downed wood may occur.

Prescribed fire

Prescribed fire treatments are a planned fire ignition used to meet a variety of vegetation-related resource objectives, including improvement of wildlife habitat, stimulate shrub sprouting, reduce stand densities, reduce forest fuels (downed wood), create openings early successional habitat, and to restore natural disturbance processes.

Past treatments acres

Harvesting has been used on the Forest as a tool used to achieve a variety of resource objectives, including but not limited to lowering fuels and fire risk; establishing desired tree species; improving tree growth; reducing impacts of insects or disease; contributing wood products to the local economy; improving wildlife habitat; and salvaging the economic value of trees killed by fire or other factors. Reliable records of timber harvest on Forest Service lands extend back to about the mid-1940s. Since that time, an estimated 16% (approximately 400,000 acres) of the total NF lands on the Forest have experienced some type of timber harvest (1940s to 2013). Looking at a more recent time period, in the period 1990 to 2013, an estimated 97,000 acres, or about 4%, of NFS lands, have been harvested.

Since 1950, approximately 119,000 acres (about 5% of FNF lands) have been non-commercially thinned, with nearly 40% (approximately 44,000) of those acres occurring from 1990 to 2013.

Planting of tree seedlings within areas disturbed by fire or within regeneration harvest units has occurred across approximately 136,000 acres (about 5.6%) of Forest lands since 1950. About 61,000 of these planted acres were accomplished from 1990 to 2013. Planting is usually conducted for the purpose of establishing desired tree species on a site where natural regeneration is not expected to be sufficient.

Modeled disturbance processes and treatments

As described in the methodology section earlier, analytical modeling was used to assist in the evaluation of trends in vegetation characteristics over time. Fire, insects, disease, and timber harvest are the disturbances that impact vegetation change in the model, interacting with climate and vegetative succession, over the five decade modeling period. This section briefly describes the modeled disturbance and treatment outputs over the modeling period. Relevant results in vegetation changes from the modeling are described in the environmental consequences sections for each key ecosystem characteristic. This section also describes some of the particulars of the modeling to be aware of when interpreting these results. More detailed information on the modeling process and outputs is found in Appendix 2 and the planning record.

Wildfire

Wildfires are expected to have one of the most substantial influence on vegetation conditions in the future. Figure 14 displays the amount of wildfire and prescribed fire as modeled over the next five decades by alternative. The acres of wildfire in this figure are unplanned ignitions that include both fires that will be allowed to burn to achieve desired vegetation conditions (wildland fire use), and fires that will be actively suppressed, but have a probability of growing to moderate or large size under certain climatic and vegetation conditions.

Though our best understanding of how fire behaves across the Forest and the effects fire has on vegetation were used to inform the model, there is an inherent degree of uncertainty. We cannot predict with high accuracy where and when fires will occur. There is also an inherently high degree of variability, both spatially and over time, in the amount and location of wildfire. The average wildfire acres displayed in Figure 14 do not imply an "even flow" of acres burned over time. The acres burned vary by decade between the simulations, from a low of about 43,000 acres to a high of nearly 380,000 acres within a decade. The model simulations reflect the reasonable assumption that under warmer climate periods drier conditions would also occur, and a higher amount of fire could be expected across the landscape. For additional discussion on fire, both historical and future, refer to the Fire and Fuels section of this EIS and to the Assessment.

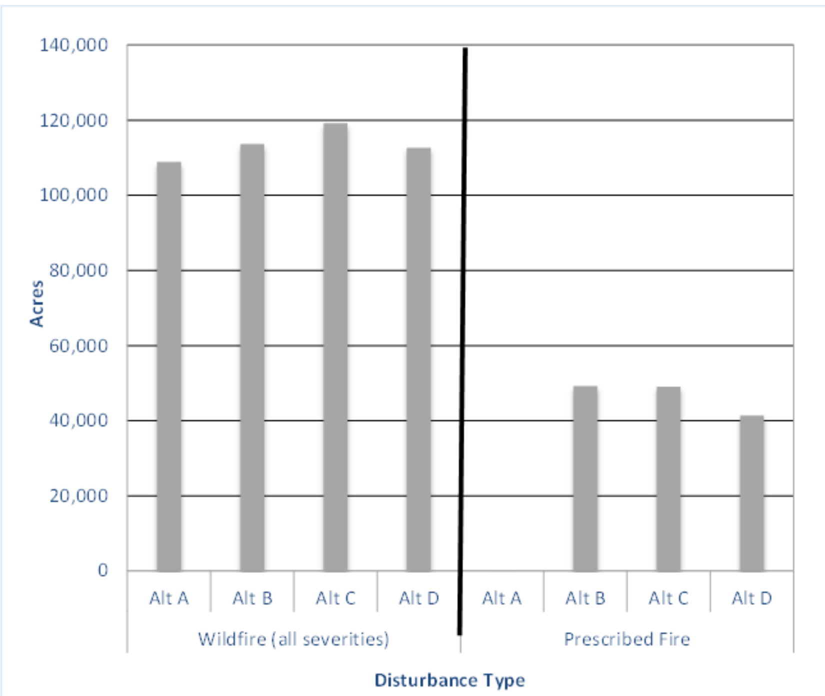


Figure 14. Average acres per decade forestwide affected by wildfire and prescribed fire, as modeled over a five decade period into the future.

Source: Spectrum model (for amount of prescribed fire, assuming a constrained budget) and SIMPPLLE model (for amount of wildfire).

Prescribed fire

The Spectrum model applies substantial amounts of prescribed fire across the Forest over the modeling period under all the action alternatives (figure 14). No prescribed fire is allowed in designated wilderness, but it may occur in other management area designations and within all biophysical settings and forest dominance types, except grand fir/cedar dominance type on the warm moist biophysical setting. Lower severity underburns are applied in the warm moist and warm dry biophysical settings, where early successional fire resistant species occur. About one quarter of the estimated prescribed burn acres are low severity fire. The remainder are moderate to high severity burns and are applied in the cool moist-moderately dry biophysical settings.

The specific desired vegetation conditions most likely to occur in the model from prescribed fire include the creation of seedling/sapling dominated forest size class, reduced forest densities and increased forest size classes by removal of smaller diameter understory trees, and the altering of species compositions to favor the fire-resistant species (especially western larch, ponderosa pine).

No prescribed fire is modeled to occur in alternative A, because the existing plan has no specific objectives or direction related to implementation of prescribed fire. However, in reality prescribed fire is and will be used as a tool to achieve desired vegetation and fuel conditions under the current plan, similarly as might occur under the action alternatives.

The model applies prescribed fire within recommended wilderness areas in all alternatives, as allowed by the plan. However prescribed fire would likely be prohibited in these areas once they become designated wilderness, and this eventual cessation in the use of prescribed fire is not reflected in this modeling process. Wildland fire use may continue to occur in the newly designated wilderness; however the ability to use this tool in many of the recommended wilderness areas is limited (refer to the discussion in the Threatened and Endangered Plant section of this EIS, related to whitebark pine).

Prescribed fire is not only limited by budget, but also weather/climate related factors and other logistical reasons. In addition, management direction in the current and revised plan related to the threatened Canada lynx, and resulting restrictions on vegetation treatments is expected to limit prescribed burning opportunities substantially (refer to section 3.2.11). These factors are difficult to reflect in the modeling, but it is reasonable to assume that the amount of prescribed burning portrayed into the future by the model is overestimated. Refer also to the Fire and Fuels Management section for further detail on prescribed fire.

Timber harvest

Timber harvest as modeled in Spectrum is of three general types: regeneration, commercial thin and group selection. Refer to the discussion earlier under vegetation treatments for a description of these types of harvest and the types of vegetation change that they typically would achieve. Table 10 and figure 15 display the acres of treatments as averaged over the five decade modeling period for each alternative.

Table 10. Acres per decade by alternative, as averaged across the five decade modeling period for each timber harvest type. Source: Spectrum model.

Alternative	Regeneration harvest	Commercial thin	Group selection harvest	Total acres harvest average per decade
A	13,625	0	5,068	18,693
B	14,202	31,454	0	45,656
C	5,263	25,554	8,089	38,906
D	14,568	13,774	2,998	31,340

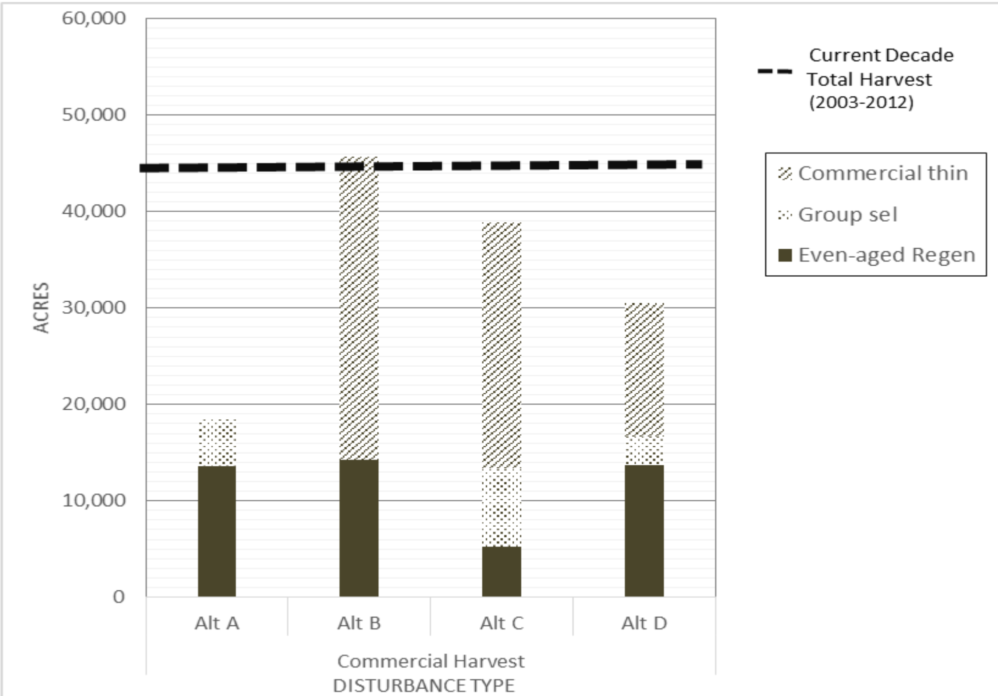


Figure 15. Average acres per decade forestwide affected by commercial timber harvest, as modeled over a five decade period into the future. Source: Spectrum model.

Regeneration harvest alters forest size classes and may alter forest densities and forest composition. Subsequent reforestation (planting or natural regeneration) occurs in regeneration harvested stands. Non-commercial thinning may occur in some stands, though is excluded from most areas on the Flathead Forest due to the restrictions on this treatment within Canada lynx habitat (refer to section 3.2.11). Commercial thinning primarily reduces forest density, but may also increase size class and change forest composition. Group selection harvest may or may not alter the current forest condition, depending on pre-harvest species composition and structure of the stand. It tends to maintain or increase the shade tolerant tree species (e.g., grand fir, subalpine fir) as compared to shade intolerant species, because of the small openings and denser forest canopy conditions.

By necessity, the models simplify treatment implementation, applying harvest treatments using very general and limited guidance, both spatially and temporally. The vegetation change resulting from the treatments is also by necessity broad and generalized. The different objective functions applied in the model influence the mix of treatment types that result by alternative (refer to discussion of modeling in appendix 2). In reality, silviculture prescriptions for harvest treatments are applied site specifically, designed to address forest conditions unique to the site, and far more variable in application and resulting vegetation conditions than is able to be depicted by the model. As required by plan direction, each prescription would be designed to meet desired vegetation conditions, and each would contribute to achieving more resilient forest conditions across the Forest. This is an underlying assumption common to all the alternatives, though it may not be well illustrated through the modeling process.

As evident by comparing the figures above, the acres influenced by timber harvest are a relatively small proportion compared to wildfire. All timber harvest activities are financially constrained in the model, using budgets similar to current levels.

Insect and disease

The model suggests that insects and disease, and particularly the bark beetles, will play a role in vegetation change over the next five decades (refer to appendix 2). The amount of insect and disease disturbance would be closely tied to the abundance of the host species; vegetative succession of these forests into more susceptible conditions (i.e., larger trees, higher densities); and the warmer climatic scenario that is modeled in the latter decades of the model period. As with fire, these are modeled estimates, based on our best available information, but associated with a high level of uncertainty. The model indicates that acres infested by bark beetles, and in particular Douglas-fir and spruce beetle, increase dramatically and remain at a high level over most of the model period. It is believed that the model substantially overestimates the amount of acres infested and length of infestation that would be expected for the Flathead Forest for these bark beetles (personal communication, 2016). This factor should be considered when interpreting the model results, because these bark beetles would affect Douglas-fir and spruce trees, in particular by removal of the large and very large trees that are most susceptible to beetle mortality, and reducing forest size class. Forest impacted by beetles may also show a decrease in forest density and shift in species composition.

The model indicates root disease and western spruce budworm would also affect forests over the five decade model period, though less acres than the bark beetles, and more similar to expected levels (refer to appendix 2). Root disease primarily impacts Douglas-fir, grand fir and subalpine fir dominated forests, potentially decreasing forest densities and shifting species composition. Western spruce budworm primarily impacts these same species, and also spruce.

3.3.3 Forest Plan Management Direction

Forest plans provide the direction designed to achieve the overall goal of maintaining or moving towards resilient and sustainable vegetation conditions on the Flathead. This section describes and compares forest plan direction within the alternatives.

Forest Plan desired conditions, standards, and guidelines

Effects of alternative A

The existing Forest Plan incorporates strategies to maintain resilient forests into the goals, standards and objectives for vegetation management and wildlife habitat. Most of this direction originates from Amendment 21 (A21) to the Forest Plan, which was adopted and integrated into the existing Forest Plan in 1999. In addition to revising old growth management direction, A21 provided broad direction related to other forest structures based on maintaining forest and ecosystem resilience. The 1986 plan does not contain explicit or quantitative desired conditions for vegetation component, but provides more general direction for management. This includes direction to manage for vegetation composition, structures and patterns that would be expected to occur under natural succession and disturbance regimes; using historical vegetation conditions and knowledge of natural disturbance regimes to guide development of desired conditions at the project-level; reducing the risk of undesirable fire, insect and pathogen disturbances; and providing for long-term recruitment of forest structural elements such as snags and downed wood. Most of this direction is located in the forest-wide objectives under section A(6)-Vegetation (pg. II-8, 1986 Forest Plan) and forest-wide standards under (H)-Vegetation (pg. II-47, 1986 Forest Plan). This direction would maintain or trend the forest towards greater resiliency at both the stand and landscape scale. Specifics related to direction provided for the different key ecosystem characteristics are described within the sections for each characteristic that comprise the rest of this vegetation section of the EIS.

Effects common to alternatives B, C and D

All action alternatives employ a similar framework and emphasis related to maintaining or achieving forest resilience. The revised forest plan for all action alternatives include specific plan components related to vegetation key ecosystem characteristics. Desired condition FW-DC-TE&V-03 highlights the overriding vision for the forests of the Flathead, which includes having "Vegetation conditions and patterns contribute to resilient forest conditions at both the stand and landscape level, having the capacity to maintain or regain normal functioning and development following future disturbances (such as fire) or in the face of future climate changes."

Specific desired conditions, both qualitative and quantitative, and based on natural range of variability, are provided for the key vegetation characteristics. They describe conditions that, to the best of our knowledge, will maintain or trend the forest towards forest resilience and sustainability. This direction provides substantially more detail and clarity as to what vegetation conditions and species compositions to strive for, as compared to the existing 1986 plan. The revised plan contains many plan components that are contribute to the maintenance or achievement of a diverse and resilient forest. These include the following:

- Desired conditions for vegetation composition (FW-DC-TE&V-8, 9 and 10)
- Desired conditions for forest size classes and very large trees (FW-DC-TE&V-11, 12, 13)
- Desired conditions for forest density (FW-DC-TE&V-14)
- Desired conditions for old growth forest (FW-DC-TE&V-15)
- Desired conditions for forest structural components of snags and downed woody material (FW-DC-TE&V-16, 17, 18)
- Desired conditions for landscape patterns and patch sizes (FW-DC-TE&V-19)
- Desired conditions for ecosystem processes (FW-DC-TE&V-23) including insect and disease (FW-DC-TE&V-20, 21), fire (FW-DC-TE&V-22), including recently burned forest conditions (FW-DC-TE&V-24).
- Objectives (FW-OBJ-TE&V-01 through -04) specifying acres of vegetation treatments to implement over the plan period, to achieve DCs for coniferous forest types and associated wildlife species; to contribute to restoration of resistant western white pine and achieve desired conditions for this species; to contribute to restoration of diverse native hardwood forest types; and to promote persistence of grass/forb/shrub plant communities.
- Guidelines and standards for vegetation management that provide direction to help achieve desired conditions and avoid or mitigate for undesirable effects. These include snag, downed wood, and large live tree retention (FW-STD-TE&V-04, FW-GDL-TE&V-09,10,11); guideline to increase resilience of old growth; and a guideline (FW-GDL-TE&V-07) to design silvicultural prescriptions that create "forests more resilient and resistant to disturbances and stressors, including climate change."

Design of components in the revised forest plan facilitates reliable and repeatable monitoring of existing conditions and trends over time, and the monitoring plan reflects this. Measurable monitoring components are important for determining how management activities and ecological processes, including climate change, may be influencing vegetation conditions and achievement of desired conditions over time.

Forest Plan management areas and management tools

Management areas represent different management emphasis on a landscape basis. In general, they reflect the degree and type of both natural and human influences (i.e., vegetation treatments) that are allowed, expected or desired to occur across the Forest. Because it is the disturbances and vegetation treatments described in the previous section (interacting with climate and successional processes) that will change vegetation over time, management areas are important to the discussion of how the alternatives differ in achieving desired vegetation conditions.

The general categories of management tools that may be used to maintain or achieve desired vegetation conditions are wildland fire use (unplanned ignitions), prescribed fire (planned ignitions), and mechanical treatments (commercial harvest, non-commercial thinning, fuels reduction treatments). Forest plan direction to meet desired conditions for other resources (such as wildlife species or recreational uses) influence and limit the types of management tools available for use to achieve desired vegetation conditions, as reflected by the management area.

The natural disturbance processes of wildfire, insects and disease affect vegetation to a substantial degree. These processes know no boundaries, and would be expected to occur across all 2.4 million acres of the Flathead Forest. Aggressive fire suppression strategies afford some control over fire extent and severity (see Fire and Fuels Management section), and vegetation conditions (such as forest densities and landscape patterns) may influence the intensity and extent of area affected by both fire and insect or disease. However, in a broad sense and considering the forest as a whole, forest managers have relatively little control over the location, extent, severity or type of vegetation change that might occur from wildfire and insect/disease disturbances.

In contrast to wildfire and other natural disturbances, use of vegetation treatments such as timber harvest, non-commercial thinning, and prescribed burning (planned ignitions) provide much more flexibility and control over vegetation changes, increasing the effectiveness of attaining desired vegetation conditions. There is greater opportunity to influence the type and rate of vegetation change towards desired conditions, because treatment location, extent and implementation is more precise and controlled.

Where fire is desired, use of planned ignitions can be conducted under weather and fuel conditions that are more likely to achieve the desired intensity and extent of fire as compared to wildland fire use. There is still the element of uncertainty as to the outcome when using fire, and favorable weather and fuel conditions can occur infrequently. Fire overall is a less precise tool for achieving desired vegetation conditions when compared to mechanical treatments.

Mechanical treatments, such as commercial and non-commercial harvest, tree planting and thinning of sapling trees, afford the most control over vegetation conditions, both short and long-term, when compared to natural disturbances or prescribed fire. Changing vegetation to move towards desired conditions can be more precisely accomplished. Desired forest densities, species compositions, and tree growth rates can be controlled through specification of trees that will be retained or removed, or planting of specific species after regeneration harvest. However, mechanical treatments are the tool whose use is most restricted across the forest, as directed by management area designation and suitability for timber production, accessibility, and forest plan direction associated with other resources, such as threatened and endangered wildlife species. Timber harvesting is limited in both in extent of area and in the types of forest conditions that are allowed to be treated. Budget constraints also limit the amount of harvest or other mechanical treatments that may occur.

Management areas 6 (general forest), 4b (Miller Creek Demonstration Forest and Coram Experimental Forest) and portions of 7 (focused recreation areas) are the areas on the forest where active vegetation management activities would have a dominant role in affecting composition, structure, and pattern of vegetation. The use of mechanical treatments would be a primary tool in these management areas. A brief description of these management areas as they pertain to vegetation management follows. Refer to appendix B, figure B-31 through figure B-48 for maps that display management areas for each alternative.

Management area 6a

Vegetation management activities have a dominant role in affecting the composition, structure, and pattern of vegetation, and maintaining or trending vegetation and wildlife habitat towards the desired conditions. Prescribed fire is likely to be the primary tool used in MA 6a to achieve desired vegetation conditions, though timber harvest (with associated planting and non-commercial thinning) would also be an important tool. MA 6a is located in areas with a higher level of other resource considerations or site limitations that would restrict active vegetation management, as compared to MA 6b or MA 6c. For example, MA 6a may be within grizzly bear security core; within high use white tail deer winter range; in important wildlife habitat connectivity areas; in areas of low site productivity; in areas with especially high scenic values; and/or within inventoried roadless areas. In combination, these and other factors are expected to result in low intensity of timber harvest, with the regularity, rate and amount of timber harvest considerably limited over time and space (unsuitable for timber production). Costs associated with timber harvest and other active vegetation management may be higher, including increased restrictions on road management and access.

Management area 6b

Vegetation management activities have a dominant role in affecting the composition, structure, and pattern of vegetation, and maintaining or trending vegetation and wildlife habitat towards the desired conditions. Timber harvest (with associated planting and non-commercial thinning) would be the primary management tool used to achieve desired vegetation conditions, but prescribed fire would also be utilized. In comparison to MA 6a, a moderate intensity of timber harvest is expected to occur in MA 6b, and these areas will have regularly scheduled timber harvest (suitable for timber production). MA 6b is located in areas where other resource considerations or site limitations are expected to restrict active vegetation management to a lesser degree than in MA 6a, but more than in MA 6c. For example, MA 6b includes areas within the PCA for grizzly bear, within white tail deer winter range, and/or within important wildlife habitat connectivity areas. In combination, these and other factors would limit the rate and amount of timber harvest over time and space. There may be increased costs associated with timber harvest and other vegetation management activities, as well as road management and access restrictions, in comparison to MA 6c areas.

Management area 6c

Vegetation management activities have a dominant role in affecting the composition, structure, and pattern of vegetation, and maintaining or trending vegetation and wildlife habitat towards the desired conditions. Timber harvest (with associated planting and non-commercial thinning) would be the primary management tool used to achieve desired vegetation conditions, but prescribed fire would also be utilized. In comparison to MA 6b, a higher intensity of timber harvest is expected to occur in MA 6c, and these areas will have regularly scheduled timber harvest (suitable for timber production). MA 6c is located in areas where other resource considerations or site limitations are expected to restrict active vegetation treatments to a lesser degree than either MA 6a or 6b. For example, MA 6c may include areas located outside the primary conservation area for grizzly bear and/or within wildland urban interface areas. In comparison to MA 6a and 6b, the rate and amount of timber harvest over time and space would be less limited, as would road management flexibility and access. Outside the primary conservation area for grizzly bear, new road construction would facilitate timber harvest where needed and where consistent with desired conditions for other resources.

Management area 4b

The Miller Creek Demonstration Forest was established to study the effect of management treatments on regeneration and other forest conditions. It is designated suitable for timber production and timber harvest would be the primary tool used to achieve desired vegetation conditions. Coram Experimental Forest also serves as a demonstration and study area for researchers, educators, forest managers, and the public. Though the experimental forest is not designated suitable for timber production, timber harvest, as well as prescribed fire, would be expected to be the primary tool to achieve desired vegetation conditions, which would be focused on research purposed.

Management area 7

Focused recreation areas typically have certain types of recreation uses featured, such as areas associated with a large lake or reservoir, or groomed cross country ski areas. Most of the lands within the MA 7 areas are designated suitable for timber production, and vegetation management activities would have a dominant role in affecting the composition, structure, and pattern of vegetation. Timber harvest would be the primary tool used, with low, moderate and high intensity as described above for MA 6a, 6b and 6c, depending on the MA 7 area.

Environmental Consequences

All action alternatives have the same set of management area designations and management area direction related to vegetation. However, acres within each management area is different between alternatives, and therefore the alternatives vary in the degree to which certain types of management tools may be used across the landscape to achieve desired vegetation conditions. Table 11 and Table 12 summarize these differences and vegetation management opportunities by alternative.

Table 11. Percent of total Forest area by alternative in management groups where different vegetation management activities may occur.

#	Management Areas Groups	Tools for vegetation management	Percent of total Forest area by alternative
1	Designated Wilderness (MA 1a)	Wildland fire use only. No prescribed fire (planned ignitions) permitted. Unsuitable for timber production and harvest is not allowed.	Alt. A: 45% Alt. B: 45% Alt. C: 45% Alt. D: 45%
2	Recommended wilderness and other similarly protected areas (MA1b,2a,2b,3a,3b,4a)	Wildland fire use and prescribed fire allowed. Prescribed fire would be the primary management tool. Timber harvest mostly not allowed and would not occur (except for recreation or scenic segments of wild and scenic river, portions of which may have very limited harvest). All areas are unsuitable for timber production.	Alt. A: 5% Alt. B: 10% Alt. C: 23% Alt. D: 3%
3	Backcountry designations (MA 5a, 5b, 5c, 5d)	Wildland fire use and prescribed fire allowed. Prescribed fire would be the primary management tool. Harvest allowed but would seldom occur and very limited in extent. Most of these areas are within Inventoried Roadless Areas, where harvest is greatly restricted by the Roadless Rule (see IRA section of this EIS). All areas are unsuitable for timber production.	Alt. A: 17% Alt. B: 13% Alt. C: 6% Alt. D: 20%
4	General Forest, Focused Recreation, and Experimental Forest (MAs 4b, 6a, 6b, 6c, 7)	Wildland fire use allowed, but would be seldom used. Prescribed fire allowed. Timber harvest would be the primary management tool. This group includes areas suitable and unsuitable for timber production (see Table 12).	Alt. A: 33% Alt. B: 32% Alt. C: 26% Alt. D: 32%

Acres suitable for timber production are displayed for each alternative in table 12 below. These areas suitable for timber production are a subset of the lands within management area group 4 in table 11. Timber harvest, with associated planting and non-commercial thinning, would be the primary tool used in these areas to alter vegetation for achieving desired conditions, providing the greatest direct control and effectiveness to achieve desired changes in forest vegetation. The intensity of expected vegetation treatments are displayed in the table, with high intensity implying somewhat less acres or frequency of harvest over time than medium, with the intent of achieving desired vegetation conditions at a more rapid pace.

Table 12. Acres and percent of total Forest lands suitable for timber production[a] by alternative and acres within different timber management intensity categories.

Timber suitability category	Alternative A	Alternative B	Alternative C	Alternative D
Medium intensity (total acres in MA6b, parts of MA7)	208,304 (9%)	459,245 (19%)	278,106 (12%)	325,970 (14%)
High intensity (total acres in MA6c, portions of MA7)	496,898 (21%)	174,046 (7%)	130,912 (5%)	310,231 (13%)
Total in suitable MAs	705,202 (30%)	633,291 (26%)	409,018 (17%)	636,201 (27%)
Total acres and % of Forest lands suitable for timber production (see appendix 2: Veg. and timber analysis,)	526,984 (22%)	499,064 (21%)	317,301 (13%)	500,443 (21%)

[a] These acres of suitable lands are less than the total of the management area acres designated as suitable, because areas/inclusions within the management area boundaries considered not suited for timber harvest have been removed. These removals include areas where harvest is considered technically infeasible (such as non-forest landtypes, rocklands, very wet soils) or where timber harvest is not compatible with plan direction for other plan components (such riparian management zones). Refer to Appendix 2 for details of analysis,and figure 1-07 to 10 for maps by alternative of these suitable lands.

Effects common to all alternatives

As is clear from table 11 and table 12, under all alternatives the great majority (over 75%) of vegetation change across the Forest will occur as a result of the disturbances of fire (wildfire and in some areas prescribed fire), insects, and disease, with mechanical vegetation treatments allowed only in very limited circumstances. All alternatives have an equal amount of area within designated wilderness, where only natural processes of wildfire and insect/disease are allowed to occur. The amount of area where mechanical vegetation treatments would be available for use to achieve desired vegetation changes is less than a quarter of the forest under all alternatives.

Forest plan desired conditions, standards and guidelines for wildlife and other resources would equally limit all alternatives as to locations, types, extent, intensity, and other factors related to timber harvest and other vegetation treatments. In addition, treatments would be equally limited in all alternatives by budget constraints. These factors mask some of the distinctive difference in management emphasis among the alternatives, and how those differences might affect harvest amounts and types were they not present.

Alternative A

Alternative A reflects the 1986 forest plan, as amended to date. It serves as the baseline for comparison with the action alternatives. The management area allocations in the current plan differ from those in the action alternatives, but have been cross-walked to the revised plan management areas for comparison purposes (refer to table 3). Alternative A has the greatest acres in the management area group 4 and in the suitable timber base. It also has the most acres of high intensity timber harvest. I could be expected that this alternative could apply vegetation management activities to achieve desired conditions across more of the landscape and at a more rapid pace than the other alternatives. This may better facilitate achievement of conditions most benefited by timber harvest and planting (i.e., increase in ponderosa pine and western white pine). However, the use of naturally ignited fire (wildfire) as a potential tool to manage vegetation outside wilderness is limited under the current plan. Fuel reduction objectives to protect values on private lands is also lacking. Refer to figure 1-01 for display of management areas in alternative A and figure 1-07 for timber suitability in alternative A.

Alternatives B and D

This alternative has about the same amount of lands in management area group 4 as alternative D and both are similar to alternative A. Alternatives B and D also have very similar amount of lands that are suitable for timber production. Therefore, in comparison to alternative C, these alternatives have greater flexibility across more lands to use the full array of active vegetation management activities, and timber harvest in particular, to more effectively achieve desired vegetation conditions. Alternative D has nearly twice the amount of timber suitable lands in high intensity category than alternative B. Alternative D could be expected to achieve vegetation change at a somewhat more rapid pace. Refer to figures 1-02 and 04 for maps that display location of management areas and B-27 and 29 for maps that display suitable timber lands for alternatives B and D.

Alternative C

Alternative C has the fewest acres in management area group 4 (26% of the Forest), and the most acres (68% of the Forest) within management area groups 1 and 2, which are the most restrictive. Alternative C has the least amount of lands suitable for timber management, and most of this is in the medium intensity category. Management flexibility regarding vegetation treatments would be most restricted under this alternative. In addition, this alternative has the greatest acres of recommended wilderness (MA 1b). The forest plan direction under the action alternatives allows the use of prescribed fire in MA 1b to achieve desired ecological conditions. It is assumed that Congress will designate these areas as wilderness at some point in the future. Current Forest direction prohibits the use of prescribed fire in designated wilderness. This tool would likely become unavailable in the MA 1b areas once they become wilderness. Therefore, future limitations on management tools would be greater under alternatives C, and reduce further the potential effectiveness in achieving desired vegetation conditions (also see section 3.3.11). Refer to figure 1-03 for display of management areas and figure B-28 for suitable lands in alternative C.

3.3.4 **Vegetation composition**

Affected environment

Vegetation composition is an important component contributing to the biodiversity of forests across the Forest. The Forest is overwhelmingly characterized by vegetation types dominated by coniferous trees. Analysis of vegetation composition is portrayed by two indicators: vegetation dominance types and by tree species presence. When considered together, these two attributes provide a clearer picture of the overall forest composition, diversity and species distribution than either would alone.

Dominance types describe the most common plant species in the forest (e.g., tree species) and give an indication of the abundance of the species on the site. Detailed information on how dominance types are determined and were assigned can be found in the publications by Barber and others (2011), and in exhibits within the planning record. Tree species presence indicates whether a tree species exists in the stand, meaning where there is at least one live tree per acre of any d.b.h. It gives an indication of how widely distributed the species is across the landscape. Since most forest stands are composed or more than one tree species, a stand can have numerous individual species present.

There are 13 native coniferous tree species on the forest, with ten analyzed in this EIS. Seven coniferous forest dominance types are identified, as well as a hardwood and grass/forb/shrub dominance type. The vegetation dominance types “subalpine fir/spruce” and “grand fir/cedar” represent areas that are dominated by one or both of those species. A few other conifer species are so limited in extent forest-wide that they have not been listed as a separate species in the analysis, though effects to these species can be determined by their association with other analyzed types. These very uncommon species are mountain hemlock and alpine larch, which are high elevation species and most closely associated with the whitebark pine forest types; and western hemlock, which is a species of warm, moist low elevation sites, most commonly found in association with western redcedar.

Figure 16 to figure 21 and table 13 display the current condition and desired range in proportion of coniferous forest dominance types and tree species presence on national forest lands, both at the scale of the entire forest and by each biophysical setting. To the best of our knowledge, the desired condition reflects sustainable and resilient forest conditions relative to vegetation composition. For all the figures and tables in this section, the source of the data for existing vegetation is FIA data using R1 Summary database (Hybrid 2011) analysis tools. The current proportion from this dataset is expressed as an estimated mean percent, with a lower and upper bound estimate provided at a 90% confidence interval. Refer to section 3.3.1 for information on the development of the desired ranges.

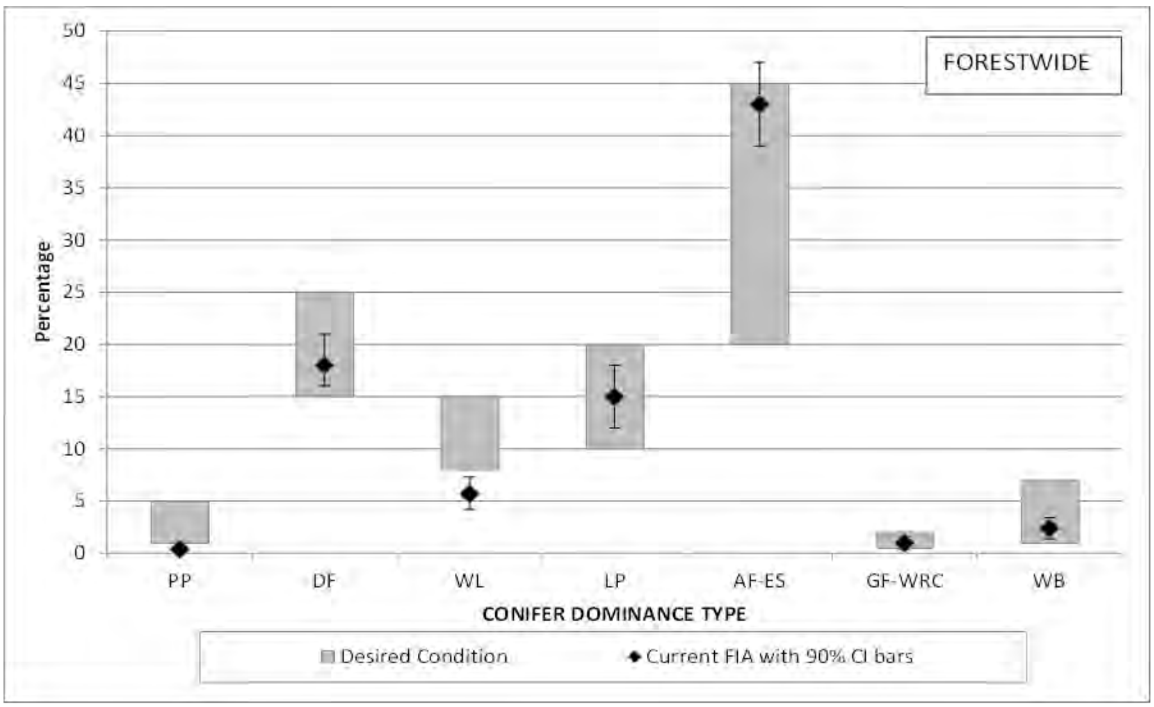


Figure 16. Current and desired condition for conifer dominance types forestwide.

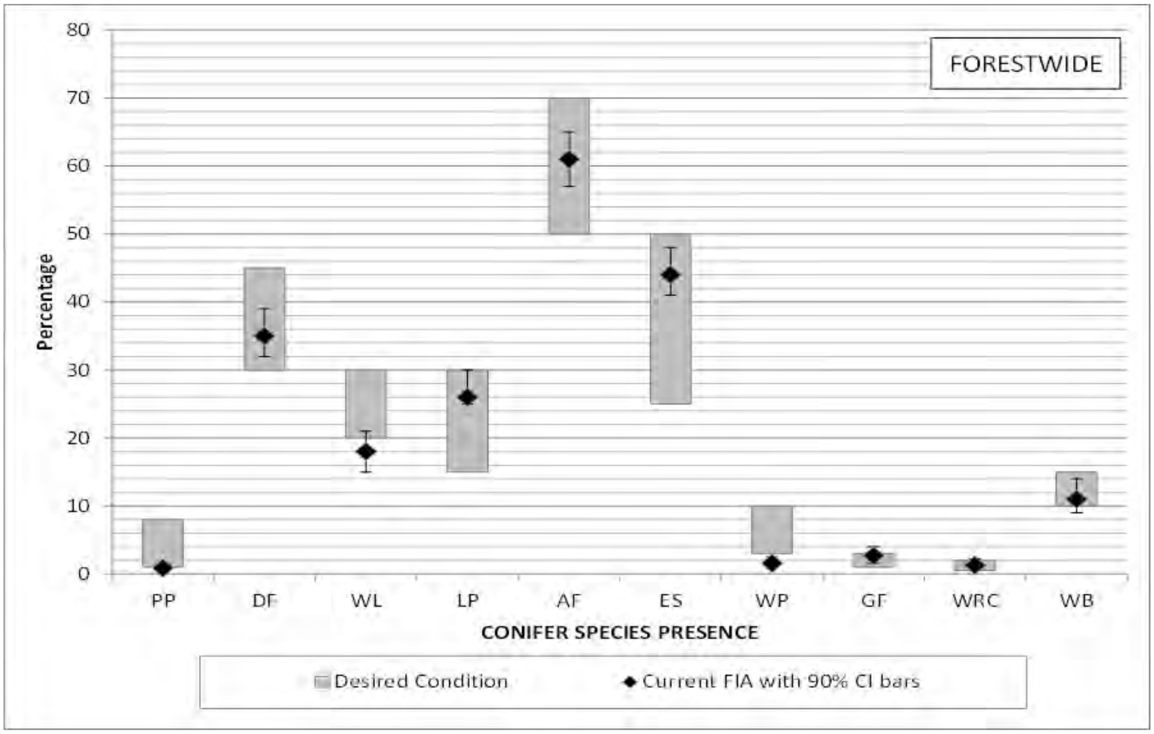


Figure 17. Current and desired conditions for conifer tree species presence forestwide.

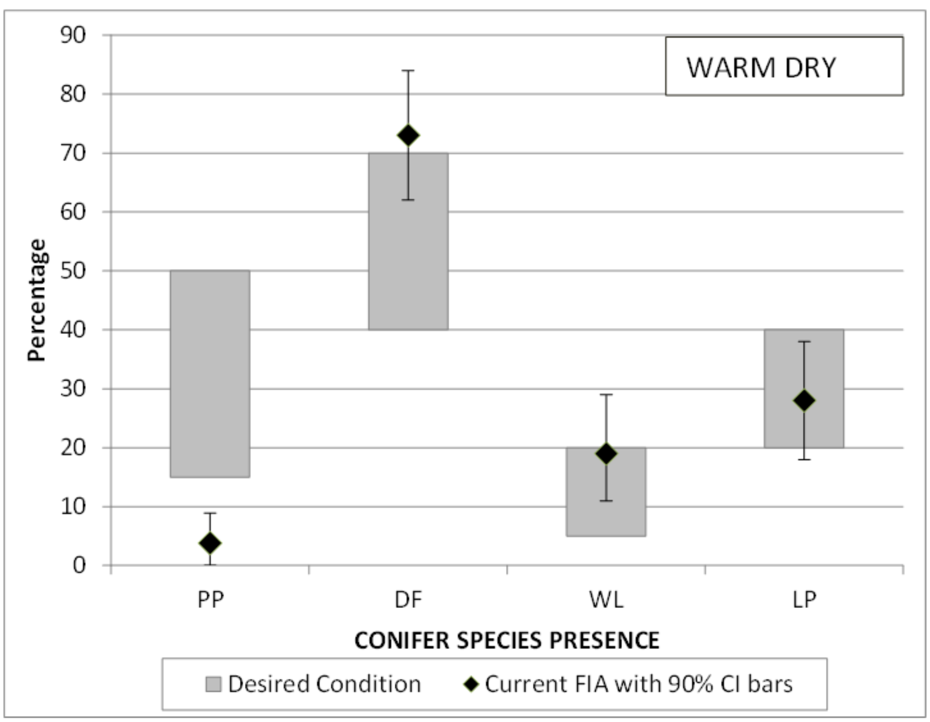


Figure 18. Current and desired conditions for conifer tree species presence on the warm dry biophysical setting.

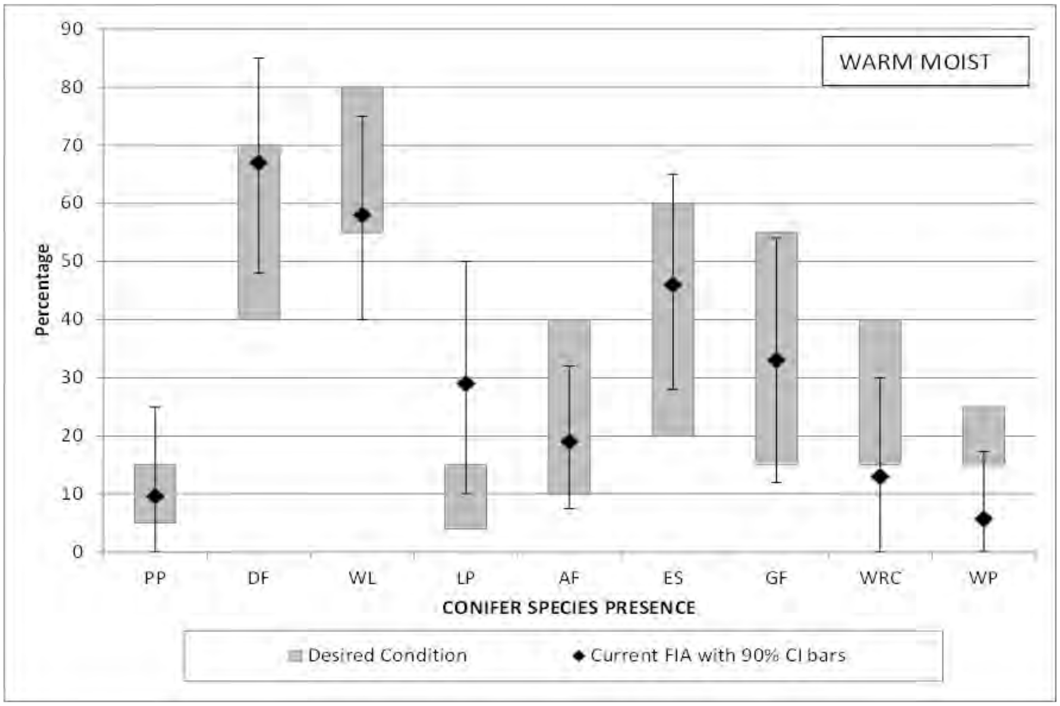


Figure 19. Current and desired conditions for conifer tree species presence on the warm moist biophysical setting

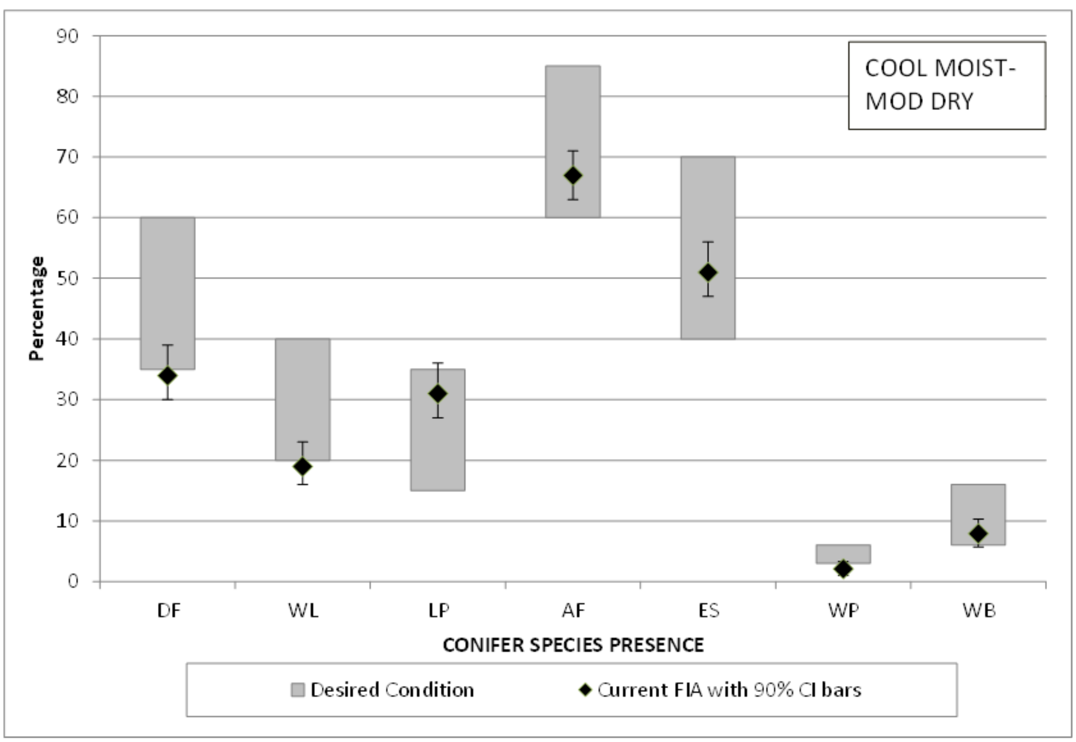


Figure 20. Current and desired conditions for conifer tree species presence on the cool moist-moderately dry biophysical setting

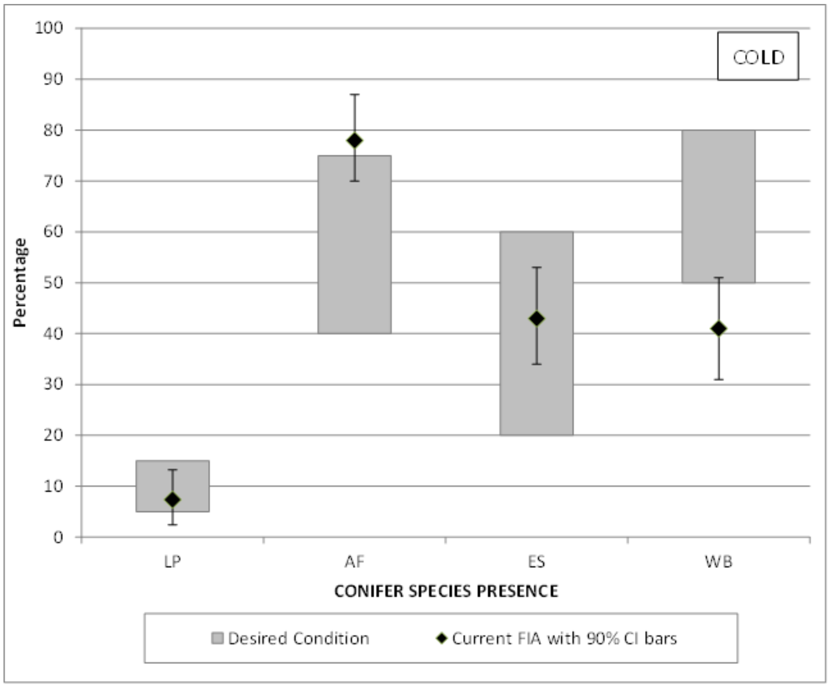


Figure 21. Current and desired conditions for conifer tree species presence on the cold biophysical setting.

Based on the current conditions of the vegetation and the desired ranges shown in the figures, desired trends for the near future (i.e., next 20 to 50 years) and areas of focus for each dominance type and species are identified and displayed in table 13. Following the table is a short summary of the characteristics of each species evaluated in this EIS and their ecological role in the forests of the Flathead.

Table 13. Desired trends over time for coniferous tree species on the Forest, forestwide and by biophysical setting[a].

Species	Dominance type – FW	Species presence
Ponderosa pine	Increase, with focus on sites currently dominated by Douglas-fir	FW and WD: Increase in all size classes
Douglas-fir	Trend downward on sites that support ponderosa pine and/or western larch	FW: Maintain near current levels, particularly in large/very large size classes WD and WM: Decrease CMMD: Maintain near current levels or increase, particularly in large/very large size classes
Western larch	Increase, with focus in areas currently dominated by lodgepole pine or Douglas-fir	FW & CMMD Increase, particularly in overstory and large/very large size classes WD & WM: Maintain near current levels or increase
Lodgepole pine	Trend downward in areas that support ponderosa pine or western larch	FW, WM & CMMD: Decrease WD: Decrease C: Maintain near current levels
Western white pine	(Not a dominance type)	FW, WM, CMMD: Increase

Species	Dominance type – FW	Species presence
Whitebark pine	Trend upward, particularly in areas best suited for species survival over time	FW, CMMD & C: Increase
Subalpine fir and Spruce	Maintain in Canada lynx habitat; trend downward elsewhere	FW: In Canada lynx habitat: Maintain both species in mid and understory canopy in Canada lynx habitat; Decrease in overstory, except in riparian management zones, where spruce should be maintained. C: Decrease subalpine fir in areas where whitebark pine occurs. FW: Decrease subalpine fir and spruce in mid and understory layers within portions of the wildland urban interface
Grand fir and western red cedar	Maintain near current levels or trend upward in areas where development of large, old cedar is supported	FW & WM: Decrease grand fir and increase western red cedar in the large/very large size classes. In Canada Lynx habitat, maintain in mid and understory tree layers but decrease in overstory, except in portions of the wildland urban interface.

[a] Abbreviations: FW=forestwide; WD=warm dry; WM=warm moist; CMMD=cool moist-moderately dry; C=cold

Ponderosa pine (PP)

This species most often dominates on the driest and warmest sites on the Forest, and usually grows in association with DF. It is of particularly high value for its contribution to species diversity, forest structure, and ecosystem resilience in the drier ecosystems. Ponderosa pine dominance type provides important wildlife habitat, particularly as late successional or old growth forest on the warm dry biophysical setting. It can live for many centuries and grow to very large diameter. It is one of the most drought and fire tolerant species in this ecosystem. Trees are capable of surviving low to moderate severity fire even at younger age classes, and can regenerate on bare soils of high temperatures. As a large tree, ponderosa pine provides important wildlife nesting/feeding habitat, both when live and dead. Also as a large, stately tree with distinctive bark color and texture that stands-out, its presence complements the scenic values. Compared to associate species such as Douglas-fir, it is less vulnerable to root disease and other pathogens. However it is shade intolerant and without disturbance that opens the forest canopy, it is gradually replaced by Douglas-fir over time on most sites.

Current conditions for ponderosa pine dominance type and species presence are below desired conditions forestwide and within the warm dry biophysical setting, and increase in this species is desired. Its presence as a species across the warm moist biophysical setting is within the desired condition. Ponderosa pine decline is likely due to a combination of factors, including fire suppression/exclusion and resulting vegetation succession, past logging and residential/agricultural development in the lower elevations. Historically wildfires were relatively frequent and of low to moderate severity on the lower elevation, drier sites where ponderosa pine dominated. Frequent fires maintained more open forest conditions with a higher proportion of ponderosa pine, which is more resistant to fire than its common associate Douglas-fir. Douglas-fir is also able to tolerate and survive under the more densely forested shaded environments resulting from succession in forests where fire has been excluded, as compared to ponderosa pine. The lower elevation sites favored by ponderosa pine are also where access for logging and development activities is readily available. The majority of the greater Flathead Valley was historically a ponderosa pine dominated forest. The vast majority has been converted to agriculture and other human development.

Western larch (WL)

This species grows on a relatively wide range of site conditions, but competes best on the cool, moist sites. Similar to ponderosa pine, it is of high value for its contribution to species diversity, forest structure, and ecosystem resilience. It also provides important wildlife habitat components in the form of very large, old live trees and snags, particularly in the late successional and old growth forest structures. Larch is of relatively high economic value for commercial wood products, and is the preferred conifer species for firewood. It has high resistance to many forest insects and pathogens. As a mature tree, it is one of the most tolerant species to fire, and can survive low to moderate severity fire when medium or larger size diameter. It is well adapted to surviving and regeneration under the mixed and high severity fire regimes typical of this ecosystem, with light seed that can spread far into a burned area, establishes on bare soil of high temperatures, and with very fast early growth rates of seedlings and saplings. It is very intolerant of shade and requires open, sunny conditions to grow and compete well against other species, as provides by high and moderate severity fire. It is not capable of regenerating and surviving in the understory tree layers within denser stands, thus unless a disturbance occurs that opens up the forest canopy, it is typically replaced over time by the more shade tolerant species. Western larch may live for several centuries and grow to very large diameters. These larger trees provide important wildlife nesting/feeding habitat, both when live and dead. The large, stately trees stand-out in the forest and its presence complements the scenic values. Also, in the autumn, the foliage turns golden before falling, providing an opportunity for recreational viewing.

Current conditions for western larch are below desired conditions as a dominance type and species presence forestwide, and below desired conditions for species presence in the cool moist-moderately dry biophysical setting. On the warm moist setting it is within desired conditions, though at the very low end of the range. In the warm dry setting it is within desired conditions at the upper end of the range. In all but the warm dry setting, an increase in the amount of western larch is desired.

Western larch is very closely linked to fire as a means of sustaining and perpetuating its presence across the landscape, and its decline on portions of the forest is likely associated with fire exclusion and suppression over the past 70+ years, followed by vegetation succession that would favor more shade tolerant species such as subalpine fir, spruce and grand fir. Timber harvest practices probably contributed by removal of larch in some areas without ensuring its re-establishment.

Recent increased amount of fire across the Forest may favor this species; however, in some of the fire areas seed sources for larch are unavailable. Western larch may be vulnerable to decline with warming climatic conditions, as it is less drought tolerant than some of its associates, such as Douglas-fir. Even with increases in fire and the presence of a seed source, warmer conditions may make some sites too harsh for larch seedlings to survive. However, larch is less vulnerable to many of the insects and diseases that may also increase with warming conditions, as compared to Douglas-fir or subalpine fir.

Potential future fire severity is likely to increase proportionally to the loss of older fire-resistant western larch and the increase in subalpine fir and Douglas-fir. Fewer large larch also means loss of their presence as a potential seed source for regeneration after future disturbances such as fire. This only serves to accentuate the decline in this species over time.

Douglas-fir (DF)

Douglas-fir is one of the more common species on the Forest, largely due to the wide range of site and forest conditions under which it is able to grow and compete successfully. It is of relatively high economic value for wood products. Similar to ponderosa pine, it is highly tolerant of drought. It is moderately tolerant of shade, and unlike ponderosa pine or western larch, it is capable of establishing and persisting in the more dense forest conditions that develop over time. Older, larger Douglas-fir trees are tolerant of fire, though less so than ponderosa pine or western larch. Trees can live for many centuries and grow to large diameters. These larger, old trees provide wildlife habitat values, though as snags they typically have less longevity than larch. Douglas-fir is one of the most susceptible conifer species on the Forest to serious damage from a variety of insect and diseases which are expected to increase under warming climate. These include Douglas-fir bark beetle, western spruce budworm, and several root diseases and heart rot pathogens. Insect and disease impacts may alter forest structures and forest fuels, increasing susceptibility to high severity fire.

Forestwide, Douglas-fir is within desired range as both a dominance type and species presence. It is within the range on the warm moist biophysical setting, though at the very high end. It is just below the desired range on the cool moist-moderately dry setting. Its low amount on this setting is probably associated to some degree with lack of fire and advancing succession, though Douglas-fir would be more able to sustain itself in these kind of conditions as compared to western larch. High mortality due to Douglas-fir beetle and root disease in the recent past may have contributed to this low current amount. Douglas-fir is a species with a wide amplitude of conditions under which it can grow and thrive, and maintaining its presence across the landscape may be an advantage in light of future changes in climate.

On the warm dry biophysical setting, Douglas-fir is above the desired range for species presence, and a decrease of this species is desired. As described under the section on ponderosa pine above, fire suppression and exclusion favors the expansion of Douglas-fir particularly on these drier forest types. The higher stand densities increases tree stress, which contributes to even greater susceptibility and mortality of Douglas-fir from various insects and diseases. Overall forest resilience is reduced and forest conditions would tend to support higher severity fires in the future, due to the higher tree densities, multiple canopy layers, greater fuels from tree mortality, and loss of the more fire resistant tree species.

Lodgepole pine (LP)

This species is capable of growing under a wide range of site conditions, from warm to cold frost pockets or higher elevations, and a relatively broad range of moisture conditions. The species is well adapted to the moderate and high severity fires that are common in this ecosystem, and serves to rapidly reforest even the largest burned areas. Though trees are thin-barked and easily killed by fire, its abundant seed production and presence of cones that are “sealed” for decades until opened by the heat of the fire allows for very rapid recolonization of the burned area by lodgepole seedlings. It has one of the most rapid early growth rates and is capable of surviving in very dense forest conditions, outcompeting other early successional species such as larch, and creating the nearly pure lodgepole stands that are common across portions of the landscape. It is very shade intolerant and comparably short lived, so over time is typically replaced by other more shade tolerant species, such as subalpine fir, unless a fire disturbance occurs.

Lodgepole pine is within desired conditions forestwide and on all biophysical settings except the warm moist setting. On that setting, it appears to be far above the desired range for species presence. It is uncertain as to the reason for this high amount of lodgepole pine across the landscape, other than as a seed source it is widespread across this setting and has benefited from the types of harvest practices and other disturbances that has occurred across this setting over the past 60 years or so.

Subalpine fir (AF) and Engelmann spruce (ES)

Subalpine fir is the most common species present across the Flathead Forest, followed closely by Engelmann spruce. These species occur on all but the driest sites on the Forest. They fulfill similar ecological roles, require similar site conditions, and often co-exist on the site, so they are combined into a single vegetation dominance type and for purposes of this description of species.

Both are very shade tolerant species, and commonly are most abundant in mid and understory tree canopy layers. Subalpine fir is the indicated climax species across most of the Flathead Forest (refer to discussion under biophysical settings in the section 3.3.1). Both species are intolerant of drought. They are also very intolerant of fire, with shallow roots, thin bark, and trees crowns that extend to the ground. They are easily killed by even low severity fires. Though they may regenerate into the opening created by the fire, they have comparably slow growth rates and are soon overtopped by other early successional species, such as lodgepole pine or western larch. However, their shade tolerance allows them to persist on the site indefinitely and eventually, over many decades to centuries, they will dominate the site, unless there is a fire event or other stand-replacing disturbance.

Subalpine fir/spruce dominance type is within desired conditions forestwide, though at the very upper end of the range. Maintenance of this dominance type is desired within lynx habitat (refer to Wildlife section of this EIS), but decreasing the dominance type outside lynx habitat is desired. The large amount of subalpine fir/spruce dominance type correlates with the low amount of western larch dominance type, again likely due to lack of fire and advancing succession, and past harvest practices, which has increased densities and abundance of subalpine fir and spruce as compared to shade intolerant species. Subalpine fir and spruce meet desired conditions for species presence forestwide and within the cool moist-moderately dry and warm moist biophysical settings. Only on the cold biophysical setting does subalpine fir presence exceed the desired range, though spruce meets desired conditions for presence in this setting. This high amount of subalpine fir correlates with the loss of existing whitebark pine due to disease, and continuing vegetative succession with lack of fire or whitebark pine regeneration.

The prevalence of subalpine fir and spruce dominated forests is tied to the frequency of fire. More frequent fires will reduce the presence and dominance of these species; long, fire free intervals and/or lack of seed source of other species will favor their dominance. Species diversity and forest resilience is dependent upon a mix of species across the forest that includes early successional fire resistant species. Forests dominated by subalpine fir and spruce tend to support higher severity fires, due to the low fire tolerance of the species, higher tree densities, multiple canopy layers, and greater litter depths and fuel loads typical in these stands. The multi-story forest conditions that typically develop in subalpine fir and spruce dominated forests are highly susceptible to damage from western spruce budworm.

Grand fir (GF) and western red cedar (WRC)

The Flathead Forest is on the far eastern side of the geographic range for grand fir and western red cedar. Sites suitable for their growth are limited, and thus they are a relatively uncommon species forestwide. Their distribution is limited to the warm moist biophysical setting. They occupy similar site conditions and fulfill similar ecological roles, so they are combined into a single vegetation dominance type and for purposes of this description of species.

Grand fir and western red cedar are the indicated climax species on sites within the warm moist biophysical setting. Though they may occupy the same sites, grand fir tends to dominate on the somewhat cooler drier sites within the warm moist biophysical setting and western red cedar on the warmer, moistest sites. They are very shade tolerant, and in most stands they are most abundant in the mid and lower canopy layers, with other species, such as western larch, lodgepole pine and Douglas-fir, more common in the overstory canopy layer.

Grand fir has comparably short life span, is intolerant of fire and easily killed by it, and is highly susceptible to various root diseases, stem decays and other pathogens. Western red cedar is capable of living for many centuries and growing to very large diameters, is moderately tolerant of lower severity fire when mature, and is more resistant to insects and disease than grand fir. Western hemlock occurs associated mainly with western red cedar in some very localized areas of the forest. Cedar, particularly the larger diameter trees, are prized for their timber value. Groves of very large, very old western redcedar trees are prized for their aesthetic and wildlife habitat values. This condition is rare on the Forest, partly due to the limited area where these species are even able to grow, and partly to the disturbance history of this ecosystem (fire and harvest practices). Both species have high tolerance of shade, which allows them to persist in the stand. Over time, without disturbance, they grow into and dominate the main canopy layers.

Current condition of the grand fir/cedar dominance type meets desired conditions. The presence of grand fir meets desired conditions forestwide and in the warm moist biophysical setting. Cedar meets desired conditions forestwide, but it below desired conditions in the warm moist setting, and an increase is desired. This low amount may be tied most closely to past harvest practices that removed cedar. Because they occur in the lower elevations and relatively accessible portions of the Forest, these forest types have been more vulnerable to human influences. Timber harvest has removed large, old cedar trees, which have particular high economic value. Harvest practices that selectively removed associated shade intolerant species, such as western white pine and western larch, have favored grand fir or cedar in some areas, but reduced overall species diversity of the stand and lowered the forest resilience. Forests dominated by grand fir or cedar have the potential to burn at higher severity, for similar reasons as described for the subalpine fir/spruce dominated forests earlier. Also similarly to subalpine fir/spruce, the dominance of grand fir and cedar is tied to the frequency of fire. More frequent fires will reduce the presence and dominance of these species; long, fire free intervals will favor their dominance.

Western white pine (WP)

The natural range of western white pine extends from the Cascade and Sierra Mountains, through the interior section of the Northern Rocky Mountains, and up into southern British Columbia. A key ecosystem component of forests throughout its range, the species is valued for its contribution to ecosystem diversity, structure, and resiliency. It is a long lived species, individuals 300 to 400 years old are common. It has relatively fast growth rages on productive sites, and can achieve great heights (e.g. 140 or more feet) and diameters (40 inches d.b.h. or greater) compared to associated species on the Forest. Because of its ability to grow tall, straight and fast, it can achieve dominance in the overstory tree layers of a forest, adding considerably to the forest structural diversity. Because of this, it contributes to wildlife feeding/nesting habitat, and complements scenic values. It provides a high value commercial forest product.

Western white pine is moderately tolerant of shade, particularly when a sapling, but requires full or nearly full sunlight to grow well. Its shade tolerance gives it a bit of an advantage over less shade tolerant species, such as western larch, in maintaining its presence on the site even if it is in the mid or understory tree layers. With its thin bark at young ages, it is vulnerable to fire damage or mortality, but becomes moderately tolerant of fire as it matures, as the bark thickens and lower branches self-prune. The prolific seeding habits and fast early growth of this species allowed it to regenerate rapidly into burned areas.

As with grand fir and western red cedar, the Flathead is at the far eastern side of the geographic range of western white pine, in the ecotone between the moist, productive ecosystems and forest types to the west and the drier, less maritime influenced ecosystems to the east and south. Optimum climate and site conditions for western white pine are limited on the Flathead. This restricts its presence, extent and abundance, and the species is largely limited to sites within the warm moist biophysical setting and on the low to mid elevation warmer, more productive sites in the cool moist-mod dry biophysical setting. An analysis of NRV and of the presence of sites on the Forest that are suited to the establishment and growth of western white pine indicates that approximately 8 to 10% of the Forest area (or up to about 200,000 acres) could support establishment and growth of western white pine (see planning record for details). However, it currently occurs on far fewer acres, for reasons described below.

Conditions and Trends

Western white pine has experienced severe decline throughout its range, due to the impacts of the exotic disease white pine blister rust (refer to discussion under Forest Insects and Diseases earlier in this section). In terms of population size in the interior northwest, western white pine is now estimated to be less than 5 percent of what it was at the turn of the 20th century (Neuenschwander and others, 1999). Similarly, populations have been severely reduced on the Flathead Forest over the past 50 years. Historically, western white pine was common on the Forest where the species was capable of growing, often occurring as a dominant overstory tree in mixed species stands with western larch, Douglas-fir and other species, and adding important structural features to the stand and across the landscape. As recently as 30 or 40 years ago, many of these large old trees were still present, but they have succumbed to blister rust, or in some cases mountain pine beetle.

Currently, there are very few acres on the Flathead where western white pine is a dominant or even a major species in the stand. The species persists, however, as a minor mature stand component or as young understory trees. Western white pine is a prolific species, and the scattered survivors continue to produce frequent and abundant cone crops, which contributes to its continued persistence across the Forest, even though there remains high mortality rates due to blister rust.

Western white pine presence is below desired conditions forestwide and within the warm moist biophysical setting (where it grows best). Loss of overstory tree canopy layers, exacerbated by factors such as fire suppression and timber harvest, contributes to increases in the proportion of subalpine fir, spruce and grand fir and to multi-canopy forest structures on some sites. This can result in increased vulnerability to high severity fire and to insects and pathogen infestation. As already mentioned, these changes tend to reduce the overall resilience of the forest.

An upward trend in western white pine is desired to restore this species to its former role within the forests of the Flathead and contribute to the diversity of species and forest structures, as well as economic value as a timber product. Where a seed source exists, western white pine continues to naturally regenerate within forest openings. These remaining survivors and seed producers appear to have some level of natural blister rust resistance. Natural selection has and will continue to occur, gradually increasing resistance to the disease within the population. Early studies indicated that on some sites, 19 percent of healthy western white pine seedlings were produced from blister-rust survivors, and 18% increase over the original population (Hoff et al 1976).

A program for developing of genetic resistance in western white pine seedling stock began in the 1950s, and resistant seedlings have been available for planting on the Forest since the 1970s. Planting of these trees forms the basis for programs aimed at restoring the species across its range, and returning it to at least a portion of its former role. The Flathead has been planting rust-resistant western white pine since the late 1970s, with approximately 22,000 acres planted from 1978 to 2013.

A study that modeled potential effects of climate change on western white pine in a drainage within Glacier National Park suggests that warming temperatures favor increased abundance of the species over existing climax and shade tolerant species, mainly because warming temperatures increase fire frequency and extent, which facilitates regeneration of western white pine (Loehman et al. 2011). This species could be an increasingly important component of the biodiversity of Flathead forest in the future. Planting of rust resistant species in openings created by both harvest and fire will be key to ensuring its expansion across the landscape and its survival to cone-producing age.

Whitebark pine (WB)

Whitebark pine is listed as a candidate species by the USFWS, and information on this species is discussed in detail in the Threatened and Endangered Plants section of this EIS (section 3.5). A brief summary will be provided here.

Whitebark pine is most common on sites in the cold biophysical setting. It competes best and most often achieves dominance on the harsher, exposed sites. It usually occurs in association with subalpine fir, spruce and sometimes lodgepole pine. It occurs as a minor species in some stands at mid elevations (i.e. down to about 5500 feet elevation), typically associated with lodgepole pine and subalpine fir. The species is a key ecosystem component of high elevations forests, where it was historically a dominant and widespread species at all stages of forest succession. As the most fire resistant and long lived species in these forests, it plays an important role in the stability of these high elevation ecosystems and in the quality of wildlife habitat, as discussed in detail in the Threatened and Endangered Plants section of the EIS.

Forestwide, whitebark pine is within the desired range for dominance type and species presence, but at the low end for both. However, in the cold biophysical setting where this species plays the most important ecological role, whitebark pine presence is below desired conditions. Maintaining or increasing these levels is desired. The species has experienced extensive mortality over the past few decades due to the exotic disease white pine blister rust, as well as other factors such as mountain pine beetle. Though whitebark pine still occurs across the landscape, most trees are small size classes (seedling/sapling or small size class), and larger trees are very scarce across much of its range. This has greatly reduced its regeneration potential. Subalpine fir has increased in abundance with the loss of whitebark pine and the lack of fire and regeneration of whitebark pine.

Hardwood trees

The primary hardwood species on the Forest are quaking aspen, paper birch and black cottonwood. Persistent hardwood-dominated plant communities are rare on the forest (see discussion under Biophysical Settings in section 3.3.1 above), and consist mostly of cottonwood stands in river bottoms and floodplain (refer to Riparian Areas and Wetlands discussion in the Aquatics section of this EIS). More commonly, hardwood-dominated communities occur as a transitional vegetation type in the earlier stages of conifer forest succession immediately after stand replacing disturbance, such as fire or harvest. Because the hardwood species on the Forest are relatively shade intolerant, they grow best in the openings created by disturbance. The current condition of broadleaf hardwood tree species is displayed in figure 22.

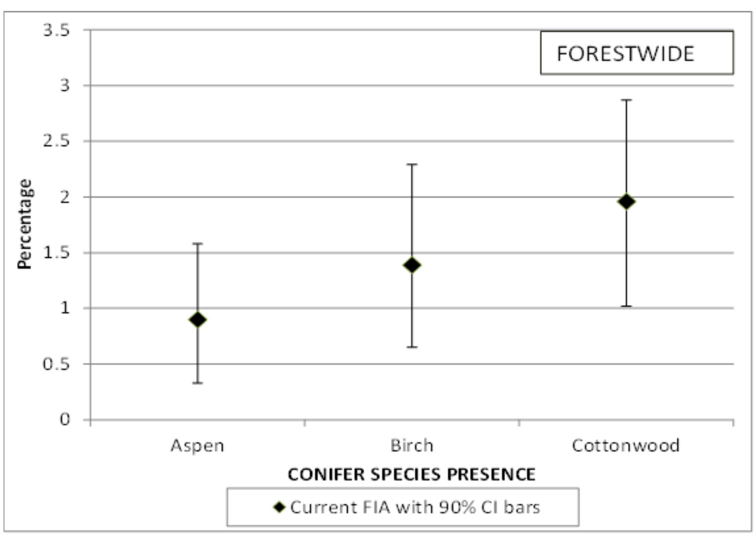


Figure 22. Current condition of broadleaf hardwood tree species presence forestwide.

Though hardwood dominated communities are not common on the Forest, they are considered an important component of the overall vegetation diversity and provide habitat for a wide variety of birds and other wildlife species (refer to Wildlife section of this EIS). As a transitional plant community, the aspen and birch types may co-exist with conifers for many decades after the disturbance, but as the conifers become more numerous and dense, the hardwoods gradually decline in vigor and numbers and are replaced by conifer dominated forest.

The desired condition for hardwood tree communities (combination of aspen, birch and cottonwood types) is a range of 0.5% to 2% forestwide. Much of the hardwood types of aspen and cottonwood occurs in the warm moist biophysical settings. Current conditions appear to meet desired conditions forestwide. To the degree that stand replacement disturbances occur (either fire or harvest) on sites conducive to hardwood tree establishment and growth, hardwood tree dominated communities will persist across the landscape.

Grass/Forb/Shrub

Similar to the hardwood communities, persistent grass/forb/shrub dominated plant communities are uncommon on the Forest. They are of two main types: (1) those on mid to high elevation relatively moist sites, usually shrub dominated but may also have abundant grasses and forbs; and (2) those on mid to low elevation relatively dry sites, usually grass dominated but may also have abundant dry-site forbs and shrubs. These persistent plant communities are maintained by harsh site conditions that slow or preclude establishment of trees, or by frequent disturbances, such as fire or avalanches. More often, grass/forb/shrub dominated communities occur as a transitional vegetation type in the earliest stages of forest succession. Through natural succession, coniferous forest cover eventually dominates on these sites, though the grasses, forbs and shrubs may remain abundant components of the understory vegetation layers throughout mid and later stages of succession.

Most high elevation grassland/herbaceous types are not substantially altered from historical (reference) conditions, largely due to lower levels of accessibility and more frequent fires in recent decades. At lower elevations within the forested environment, some of the grass/forb dominated communities are trending towards higher tree and shrub canopy cover, due to less frequent fires that kill small coniferous trees/shrubs in the understory or encroaching around the perimeter. On private valley-bottom lands adjacent to the Forest, the trend has been to convert native grasslands to crop lands and developed lands, leading to the disruption of processes, such as fire, that played a role in maintaining them. Connectivity of grassland/herbaceous ecosystems has also been affected by development at these at lower elevations, except within in the Bob Marshall Wilderness Complex. Invasive plants also are a threat to grass/forb/shrub communities in the lower elevations.

Similar to hardwood tree communities, sustaining a diversity and desired amount of grass/shrub dominated plant communities is dependent on disturbance processes that create openings, either through fire or harvest.

Environmental consequences

Effects of Alternative A

Alternative A would retain all the existing 1986 Forest Plan direction regarding the management of forest vegetation and the terrestrial ecosystem. The 1986 Plan does not explicitly describe desired conditions for overall vegetation composition, nor are there any specific numeric desired ranges for forest composition either forest-wide or by biophysical settings. However, the existing Forest Plan does incorporate an ecologically-based approach in many of the goals, standards and objectives related to vegetation and associated wildlife habitat, both forest-wide and for potential vegetation types (e.g., biophysical settings).

This includes direction to manage for vegetation composition that would be expected to occur under natural succession and disturbance regimes and using historical vegetation conditions and knowledge of natural disturbance regimes to guide development of desired conditions at the project-level. Most of this direction for management of vegetation is located in the forest-wide objectives under section A(6)-Vegetation (pg. II-8, 1986 Forest Plan) and forest-wide standards under (H)-Vegetation (pg. II-47, 1986 Forest Plan). This direction is designed to maintain or trend the forest towards greater resiliency at both the stand and landscape scale.

There is little to no direction in the current forest plan that provides for development and sustainability of non-coniferous vegetation types.

Effects common to Alternatives B, C and D

The revised forest plan for all action alternatives include specific plan components related to vegetation composition that will contribute to biodiversity and ecological integrity of the Forest. This direction provides substantially more detail and clarity as to what vegetation conditions and species compositions to strive for. The direction is based on analysis of NRV and natural disturbances that, to the best of our knowledge, will maintain or trend the forest towards forest resilience and sustainability.

This direction includes quantitative and qualitative desired conditions for vegetation composition (FW-DC-TE&V-8, 9 and 10), specific guidelines that direct treatments to maintain or move towards vegetation desired conditions (FW-GDL-TE&V-06, 11) and objectives that specify the range of acres to treat to achieve desired vegetation conditions (FW-OBJ-TE&V-01 through 04). The objectives are specific to treatments that will promote not only overall desired conditions for vegetation composition, but specifically for western white pine, and for sustaining transitional and persistent non-coniferous plant communities (hardwood and grass/forb/shrub communities). Direction is expected to result in maintaining or increasing both the presence of species of particular importance for future forest resilience (early successional fire resistant conifers), and the more uncommon plant communities that contribute to overall plant community diversity (hardwood and grass/forb/shrub communities).

Design of components in the revised forest plan facilitates reliable and repeatable monitoring of existing conditions and trends over time, and the monitoring plan reflects this. Measurable monitoring components are important for determining how management activities and ecological processes, including climate change, may be influencing vegetation conditions and achievement of desired conditions over time.

Modeled comparison of alternatives for vegetation dominance types and tree species presence

Coniferous vegetation types

Ponderosa pine shows a substantial and desirable upward trend forestwide and within the warm dry biophysical setting under all alternatives. Both ponderosa pine dominance type and species presence achieve desired conditions by the fifth decade, with occurring on a little over 1% of the forest for each. Within the warm dry biophysical setting, its presence does not quite advance into the desired range by decade 5 but it is heading in the right direction. Alternative D shows the greatest increase of up to 6% over current conditions for area where ponderosa pine is present, followed by alternative B with an increase of about 4%. Timber harvest followed by planting of ponderosa pine is a key means of increasing both density (dominance) and presence of ponderosa pine on the Forest. Both alternative D and B have similar amounts of lands suitable for timber harvest and amounts of regeneration harvest. Prescribed burning also favors ponderosa pine once it is established and can tolerate the low severity burning. This is likely contributing to the increase in this species in alternatives B and D also, and probably accounts for the lower rate of increase in alternative A (3%), which has no prescribed burning. Alternative C shows the least gain in ponderosa pine presence on the warm dry setting (about 2%) and dominance type. This is likely associated with the lower amount of harvest within this alternative.

Douglas-fir meets desired conditions for dominance type forestwide under all alternatives, with maintaining levels near current conditions (alternatives A, C and D) or decreasing it slightly (alternative B). Presence of Douglas-fir forestwide decreases over the five decade period to the low end of the desired range in all but alternative A, where it stays at about the same amount as currently. Most of this decline appears to be occurring in the warm dry setting, which shows a substantial drop in the area where this species is present. This is a desirable trend for this setting, and brings the species down into the desired range for all alternatives. Alternatives C and D shows the greatest decline of 17%, closely followed by both alternatives B (12%) and A (8%). Douglas-fir presence also decreases in the warm moist biophysical setting for alternatives B and D (about 1 to 3%), which is a desirable trend. Douglas-fir increases in the warm moist setting under alternative C about 5%, an undesirable trend that brings the species to above the maximum desired range by the fifth decade. The lower amount of regeneration harvest and higher amount of commercial thinning in alternative C as compared to alternatives B and D may partially explain the increase in Douglas-fir in the warm moist setting. Thinning in stands with Douglas-fir would tend to favor this species, whereas regeneration harvest would tend to convert areas to other species, such as western larch and western white pine. This connection appears to be evident in that alternative C also has the least increase among the alternatives in western white pine and one of the least increases in western larch on the warm moist setting.

Western larch shows a small but discernable and favorable trend over the model period. Forestwide all alternatives show a similar increase in dominance type of up to 2%, and though western larch dominance type does not quite achieve desired minimum levels forestwide by the fifth decade it appears to be progressing toward it. Species presence forestwide does not change, and the species remains below the desired range. Species presence in the cool moist mod dry biophysical setting also shows no change. An increase is desired in this setting as well, though it currently is within the desired range at the low end. There is a small but desirable increase of western larch presence in the warm moist biophysical setting of up to 2% under alternatives A and D and 1% under alternatives B and C, and the species remains within the desired range. A decrease of at least 4% in western larch presence occurs under all alternatives in the warm dry setting, and the species remains within the desired range. This shift could be associated with the increase in ponderosa pine. With warming climates, sites within the warm dry setting will be less suited to western larch, and more suited to ponderosa pine. Overall, these results suggest that western larch species appears to be increasing in abundance on the sites where it currently exists on the forest, but is increasing its distribution across the landscape only in the warm moist biophysical setting, and its distribution is decreasing the warm dry setting. The persistence of Douglas-fir and subalpine fir and their increase in both presence and dominance types by vegetative successional processes may be factors limiting the spread of western larch.

Lodgepole pine trends downward for both dominance type and species presence in all alternatives and on all biophysical settings except cold, where it stays at current conditions. The downward trend is generally desired, though is steeper than expected and sometimes drops to below minimum desired levels at the fifth decade. Mountain pine beetle impacts is the likely reason for this drop in lodgepole, though it is likely overestimated, as described in the section above discussion the modeled ecosystem processes and disturbances.

Western white pine presence shows a relatively small change at the forestwide scale under any of the alternatives, but substantial difference between alternatives occurs on the warm moist setting, where this species is most desired. Alternatives B and D both show the greatest increase of 6% in area where this species is present. Alternative A also shows a strong increase of about 4%. Alternative C shows the least increase of about 1+%, which likely is due to the low amount of regeneration harvest (and subsequent planting of rust-resistant western white pine) in this alternative. Natural regeneration may also contribute to increase in western white pine, particularly within fire areas, and in anticipated warmer temperatures in the future.

Whitebark pine shows a small and similar gain in dominance type and species presence under all alternatives. Dominance type increases about 2 to 3% forestwide, and species presence in the cold biophysical setting increases about 1 to 2%. Prescribed burns and wildfire are likely responsible for this trend, as there is no timber harvest in the areas where whitebark pine occurs. However, the limitations on whitebark pine restoration on the Flathead, and particularly the severely limited natural seed source (see discussion on whitebark pine in the Threatened and Endangered Plant section of this EIS), may not be well portrayed in the model. The recovery trend for whitebark pine is expected to be very slow, and planting of rust resistant seedlings is believed to be a particularly important activity, which is not reflected in the model.

Subalpine fir shows variable trends among the alternatives and across the different biophysical settings. Presence of this species currently is within the desired range except on the cold biophysical setting, where it is slightly above the maximum desired level. Overall, maintaining subalpine fir presence near current levels or decreasing it is the desired trend forestwide and in the biophysical settings. On the cold biophysical setting, a desirable downward trend is indicated in all alternatives, with alternatives A, C and D seeing a potential decrease of about 8%, and alternative B showing the greatest potential decrease of up to 16%. For all action alternatives, in the cool moist-moderately a small decline of at least 2% is indicated, and in the warm moist an increase of at least 2 to 6% is indicated. Alternative A shows the opposite trend, increasing slightly in the cool moist-moderately dry, and decreasing slightly in the warm moist. Trends and differences in subalpine fir are most likely connected to the amount and location of wildfire and prescribed fire across the landscape, which would both be more prevalent in the cool moist-moderately dry setting. Vegetative succession is responsible for increases in subalpine fir presence, as this species is the primary shade tolerant species and indicated climax species across nearly 80% of the Forest.

Engelmann spruce has a similar ecological role and response to fire as subalpine fir. Fire will reduce its presence; vegetative succession will increase its presence, though it is typically less abundant than subalpine fir. Similarly to subalpine fir, maintaining or decreasing this species presence is desired. Forestwide, spruce declines to a similar degree among all the alternatives, dropping at least 7% forestwide, though still remaining well within the desired conditions. Most of this decrease occurs in the cool moist-moderately dry setting, where it declines 14% by the fifth decade, and falls below the desired range. In the cold setting, spruce generally remains near its current level by the fifth decade under all alternatives. In the warm moist setting, there is wide variation among the alternatives in trends, with alternative C and D showing a decline up to about 6%, alternative B an increase of at least 3% and alternative A a decline of at least 14%. In all these cases, except for the cool moist-mod dry setting, spruce remains well within the desired condition. The strong downward trends are likely associated with fire, similarly to subalpine fir. However, the more pronounced decline of spruce as compared to subalpine fir is also due to the large amount of spruce bark beetle that is indicated in the model. As explained earlier, tThe impacts of spruce beetle are likely overestimated in the model.

Subalpine fir/spruce dominance type shows the greatest potential increase forestwide in alternative A of up to 4%, followed by alternatives C and D with potential increase of up to 3%, and the least potential increase in alternative B of up to 1%. This dominance type remains at the high end of the desired range. Desired conditions are to maintain this type in Canada lynx habitat, though a gradual decrease of subalpine fir/spruce dominance type as it is replaced by western larch dominance type is desired as well,, where subalpine fir and spruce would remain in the understory but western larch would be more prevalent in the overstory.

Grand fir occurs only in the warm moist biophysical setting, where it generally maintains its current presence across the landscape under alternatives A, C and D, with alternative B showing a decrease of up to 5% by the fifth decade. Alternative B best meets the desire for a decrease in this species, though all alternatives remain well within the desired range.

Western red cedar also occurs only in the warm moist biophysical setting, and is currently below the minimum desired level. Presence of this species increases under all alternatives and advances into the desired range, with the greatest and most desirable increase in alternative B of up to 9%. Alternative C shows a potential increase of about 7%; alternative D and increase of about 6%; and alternative A and increase of about 3%. Vegetative succession is the likely reason for the increase in this species, coupled with relatively low amount of wildfire in this setting.

Grand fir/cedar dominance type occurs only on the warm moist biophysical setting, and occupies the smallest area of all the dominance types forestwide. The model shows an increase over the five decade period under all alternatives, from the current 1% up to 2 to 3% of the areas forestwide. This is above the maximum desired level, but by a small amount when considered on the scale of the entire forest. The increase is clearly tied to the similar trend in western red cedar described in the previous paragraph, and for similar reasons.

Non-coniferous vegetation types

Trends over time in the non-coniferous vegetation types (hardwood and grass/shrub plant communities) are difficult to portray through modeling. The persistent non-forest plant communities are relatively rare types on the Forest and there is no specific direction within the model to sustain these types. However, the model results combined with an understanding of the association of these non-forest types with disturbance processes, particularly as transitional plant communities, provides information for assessment of trends over time

The **grass/forb/shrub non-forest type** shows an increase in decade 5 under all action alternatives, but a decrease in alternative A. Alternative C shows the greatest increase of up to 3%, which is above the desired maximum level. Alternatives B and D show about a 2% increase, right at the maximum desired, and alternative A shows a decrease up to 3%, placing the condition below desired minimum level. The grass/forb/shrub type is largely transitional on the Forest and is created by fire. Wildfire patterns over the model period are similar under all the action alternatives, but the pattern of prescribed fire over the model period is not. Alternative A shows very little prescribed fire in the first two decades, but a great deal of prescribed fire in the last three decades. This is the main reason for the high amount of grass/forb/shrub in the fifth decade for alternative C. Amount of area in grass/forb/shrub communities would vary widely by decade, depending upon time since the fire events.

Hardwood dominance type appears to trend upward to a similar degree under all alternatives, increasing about 1% over the current amount by the fifth decade, which is near the maximum desired condition. Similar to the grass/forb/shrub type, these changes are likely closely linked to the amount of fire. The increase in fire in the future suggests that the presence of aspen and birch are likely to increase overall as they regenerate into the openings created by fire, particularly on the moist sites and riparian areas. Cottonwood is more tied to riparian areas and wet sites, with regeneration facilitated more by hydrological conditions and events, such as flooding and high water tables, rather than fire.

3.3.5 Forest Size Class

Affected environment

Forest size classes are defined based on the predominant tree diameter (d.b.h.) in the stand. These different size classes are grouped for purposes of broad-scale forestwide analysis in this EIS. For details on how forests are classified into size classes, see Barber and others (2011) and exhibits in the planning record. Refer to publications planning record exhibit for detailed information on how forest stands are classified into size classes within the datasets used within this analysis (R1 Summary data base and R1 VMap). Five forest size classes are used in the vegetation analysis for this EIS, that broadly describe and quantify the diversity of forest sizes classes and successional stages across the Forest: Seedling/Sapling, Small tree, Medium tree, Large tree and Very Large tree. A brief description of each of the forest size classes is provided below. A general association of the size classes with tree ages and forest successional stages is made based upon a general knowledge of common forest successional patterns and structures on the Flathead in stands of different size classes.

Seedling/sapling size class represents the youngest forest conditions, and the early successional stage of development. Forests are dominated by trees in the seedling size classes (less than 4 ½ feet tall) and sapling size class (0.1 to 5 inches d.b.h). There may be very low numbers of overstory larger trees present. Most trees are less than 40 years old and less than 40 feet tall. On sites of lower productivity (higher elevation, poor soils) or in extremely dense stands, trees in in this class may actually be older than 40 years, because of their slower diameter growth rates. In this early successional stage, ample sunlight is able to reach the forest floor and abundant grasses, forbs and shrubs are a dominant feature within most areas.

Small size class forests are considered in the mid-successional stage of development, composed mostly of young, immature trees. Trees 5 to 8.9 inches d.b.h. dominate. Typical tree ages would range from 40 to 75 years old. They are most often single canopy layer, but two or more canopy layers are not uncommon, depending upon disturbance history and site conditions. Most stands are relatively densely stocked, with greater than 40% tree canopy cover, and with limited sunlight reaching the forest floor. Shade tolerant understory grasses, forbs and shrubs will dominate, with species varying by site. However, an estimated 25% of forests in this size class have more open tree canopy with 25-40% canopy closure. In these open forests, understory plant species requiring greater amounts of sunlight are more prevalent.

Medium size class forests are considered in the mid-successional stage of development. Trees 9 to 14.9 inches d.b.h. dominate. Forest structures vary considerably, with forests of single and multiple canopy layers, and mostly well stocked with trees, greater than 40% canopy cover. Shade tolerant grasses, forbs and shrubs will usually dominate forest floor vegetation, with species varying considerably by site conditions. Tree ages can also be variable among stands in this medium size class, depending on species composition, site conditions, and stand densities. A typical tree in the medium size class would be 75 to 110 years old. However, on some of the more productive sites, where stands are of optimum densities and fast growing species are present, trees of this size class may be as young as 50 years old. In other situations, such as on harsher growing sites or in stands of very high densities that had low growth rates for many decades, trees in this medium size class might be substantially older than 120 years.

Large size class forests are usually (but not always) older than those classified as medium tree size class. Trees 15 to 19.9 inches d.b.h. dominate. Most trees are over 90 years old, and most stands are considered to be in the mid-successional stage of development. Some stands are old enough to be considered late successional (e.g. greater than 140 years old). As with the medium size class, there are sites and stand conditions where trees of large tree size classes are of substantially younger ages (such as 70 years old), or of very old ages (such as greater than 200 years old). Forests in the large tree size class are usually composed of two or more canopy layers, well stocked with trees, and have greater than 40% canopy cover. Shade tolerant trees and other vegetation typically dominates in the understory, with species varying considerably by site.

Very large size class forests represent the oldest forest stands, where trees >=20 inches d.b.h. dominate. The larger trees are typically over 130 years old, and some of the oldest trees may be several centuries in age. Forests are considered in the late successional stage of development, and they correlate fairly closely to old growth forest (see Old growth section later). These forests typically have a more complex structure than other successional stages, with more variability in canopy layers, amounts of snags and down wood, and of individual tree size classes. Shade tolerant species dominate in the understory. Most sites in this category are well stocked with trees and have fairly dense canopy layers (>40% canopy cover), except on less productive sites where trees may be more widely spaced.

Figure 23 thru figure 27 display the current condition and desired range in proportion of forest size classes on national forest lands, both at the scale of the entire forest and by each biophysical setting. To the best of our knowledge, the desired condition reflects sustainable and resilient forest conditions relative to forest size class and diversity of forest successional stages. Discussion and evaluation of forest size class current condition relative to the desired conditions follows the figures. For all the figures in this section, the source of the data for existing vegetation is FIA data using R1 Summary database (Hybrid 2011) analysis tools. The current proportion from this dataset is expressed as an estimated mean percent, with a lower and upper bound estimate provided at a 90% confidence interval. Refer to section 3.3.1 for information on the development of the desired ranges.

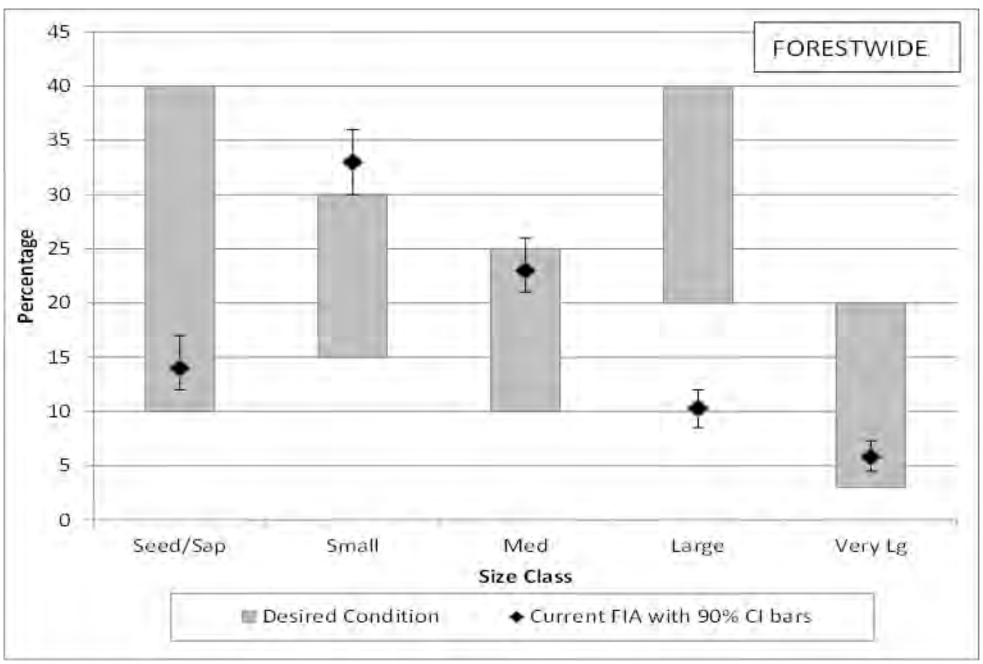


Figure 23. Current and desired conditions of forest size classes forestwide.

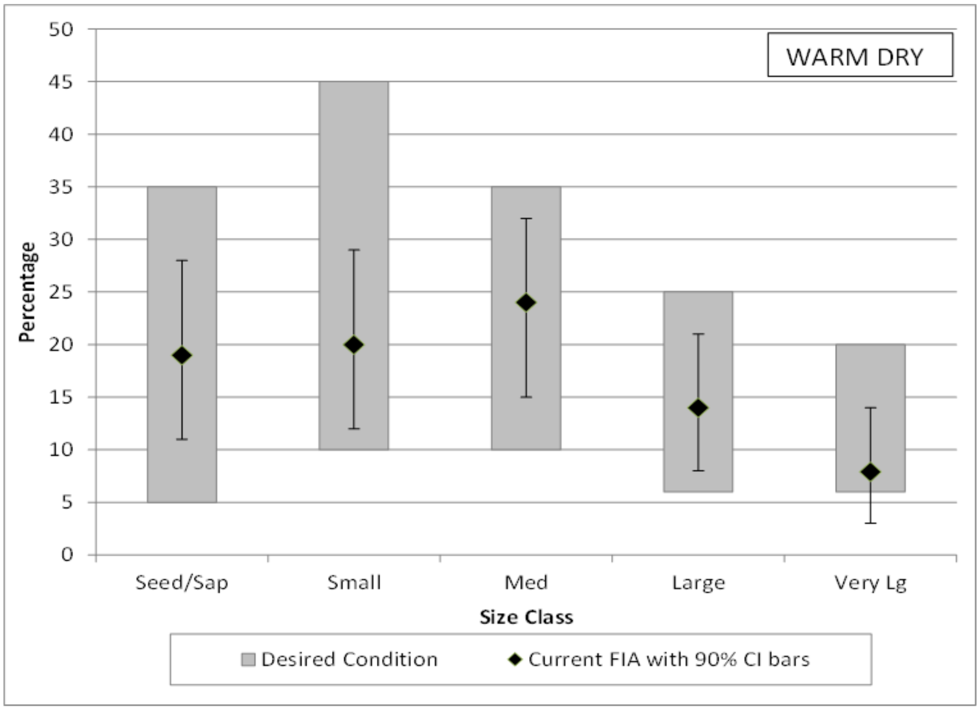


Figure 24. Current and desired conditions of forest size classes for the warm dry biophysical setting.

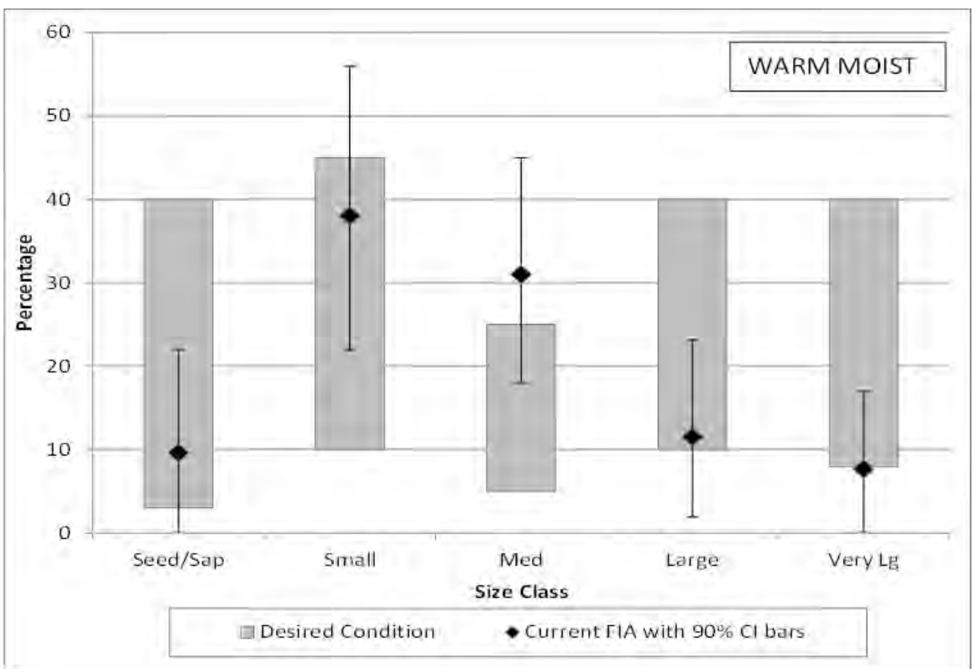


Figure 25. Current and desired conditions of forest size classes for the warm moist biophysical setting.

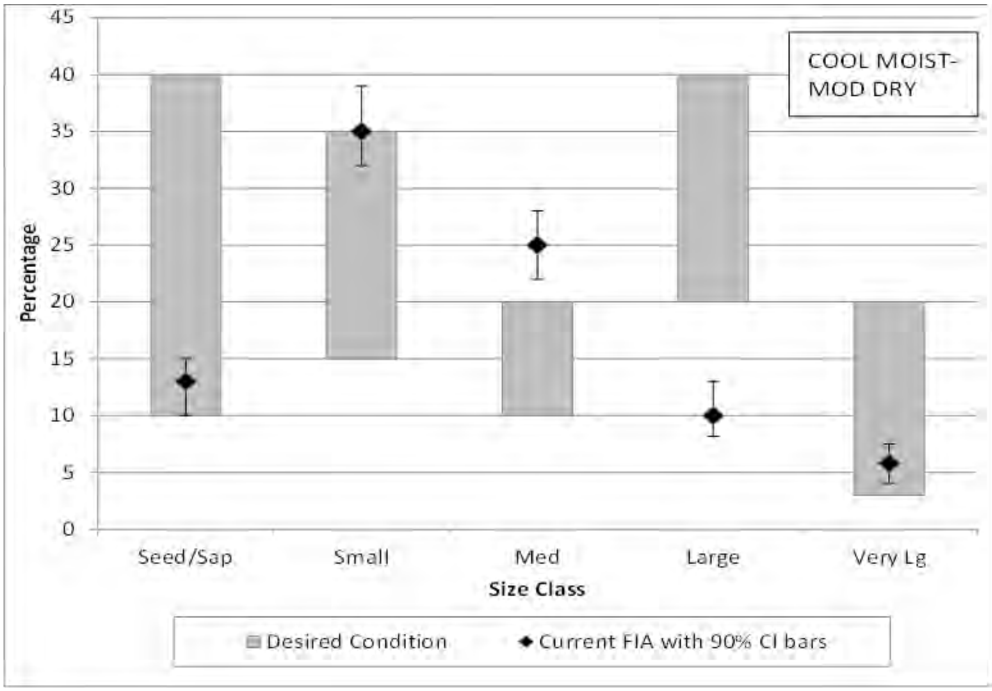


Figure 26. Current and desired conditions of forest size classes for the cool moist-moderately dry biophysical setting.

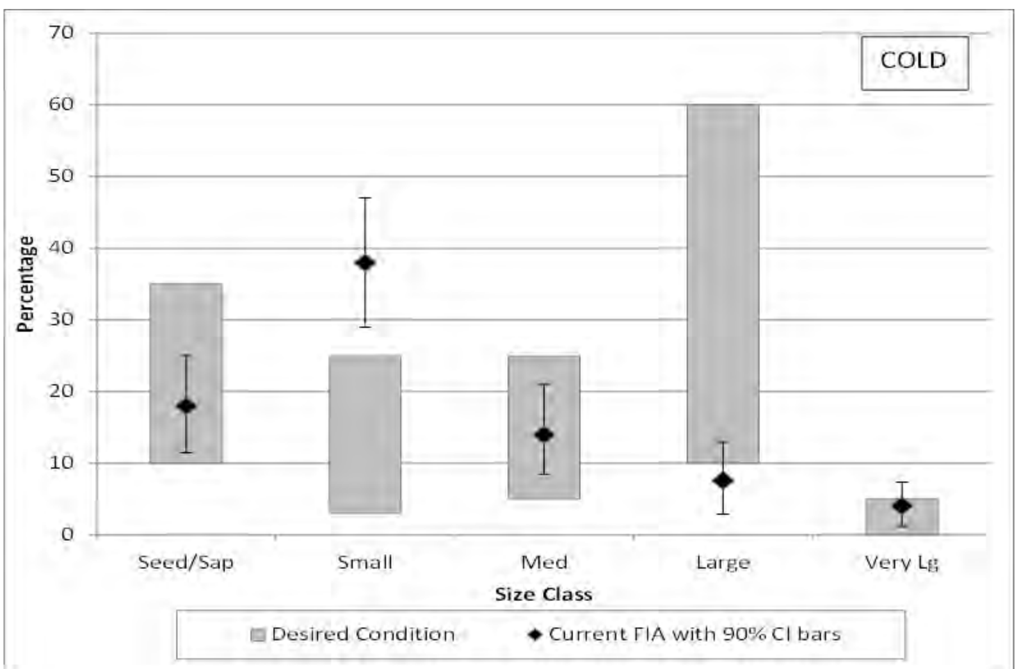


Figure 27. Current and desired conditions of forest size classes for the cold biophysical setting.

Across most of the Flathead Forest, desired forest size class distribution follows a pattern that is generally consistent with the predominant disturbance regime in this landscape, namely relatively infrequent fires that are largely moderate and high severity, and with the potential for very large and extensive areas to burn periodically (refer to Fire and Fuels section for additional information). A wide range in proportion of seedling/sapling forest types would be expected and desired, as well as a naturally lower level of very large forest size class. Most of the forest would be in the small to medium and large size classes, where they can remain for very long time periods. Proportions would shift between these size classes over time, due both to different rates of growth and succession, and in response to fire frequency and patterns. Less dense forests or forests on more productive sites would transition through these size classes and into the very large tree size class relatively quickly (e.g., 100 years from fire event). Higher density forests may take 140 years or more to transition. Many would never achieve the very large size class, due to stand conditions and/or to disturbances of fire, insect and disease.

The desired forest size class distribution on the warm moist biophysical setting reflects the high site productivity of these lands, as well as the more mixed severity fire regime. Forests in the small and medium forest size classes would be expected to transition more rapidly into the large and very large size classes, which are more abundant in this setting. Abundance of very large trees of fire resistant species (such as western larch, Douglas-fir and western white pine) would reduce fire severity and contribute to the persistence of the very large tree size class. This pattern also is indicated in the cold biophysical setting. Though there is expected to be very little forest that achieves the very large size class due to growing conditions in the cold setting, the large tree size class was historically dominated by whitebark pine, and to a lesser extent spruce. Fire regimes were more mixed severity, and the fire resistance of whitebark pine and its uniquely adapted regeneration strategy (refer to discussion in Threatened and Endangered Plant section 3.5) perpetuated its presence as mature, large diameter trees across large portions of this setting.

The desired condition for forest size class in the warm dry setting reflects a fire regime characterized by generally more frequent but mixed severity fires. Moderate severity fires would be common, but high severity fires would also occur periodically. The sites within the warm dry biophysical setting on the Flathead consist of sites at the moist end of the habitat types typically included within this group. Douglas-fir, and in some areas grand fir, are the indicated climax species. They are distributed widely across the mid to lower elevations within the matrix of more moist and cool forest types. The desired condition is for all forest size classes to be relatively well represented across these sites, and variability between amounts of size classes relatively low.

The current pattern of forest size classes across most of the Flathead indicates an overabundance of the small and medium forest size class (mid successional forests) correlated with a low amount of the larger forest size classes and, to a lesser degree, the seedling/sapling early successional forests. The source for the vast majority of the current seedling/sapling forests is recent fire. In the past twenty five years, a large amount of area on the Flathead has burned in wildfires (over 400,000 acres, or about 17% of the forest), mostly high severity burns. As a comparison, approximately 72,000 acres, or about 3%, of Forest lands have been regeneration harvested, creating early successional forest, over that same 25 year time period.

Current conditions of large and very large size classes are in the lower end of the desired range forestwide and within the biophysical settings. Fire is a natural disturbance, and is the primary factor that has historically limited the amount of very large forest size classes in this ecosystem. Large amounts of wildfire across the Flathead Forest in the late 1800s and early 1900s created large expanses of early successional forest at that time (refer to Fire and Fuels Management section of this EIS). Forests within these burn areas have only recently reached the point where some may be transitioning through succession into the very large size class. The amount of large and very large size class may have been naturally at lower levels across the Flathead prior to the onset of timber harvest activities (1940s) and the large fire events of the last 15 years. Recent fires burned within forests of all size classes, and undoubtedly are responsible for a loss of large and very large size classes. Insect outbreaks (particularly Douglas-fir and spruce beetle) and disease also removed large trees across the Forest, particularly of whitebark pine in the cold setting and western white pine in the warm moist setting. Harvest practices over the past 60+ years have contributed to the removal of the larger forest size classes.

Very large tree subclass

Very large diameter live trees (>= 20 inches d.b.h.), and in particular the more long lived, fire tolerant western larch, ponderosa pine and Douglas-fir, are identified as a key ecosystem characteristic on the Flathead Forest. Their presence within the forest is valued whether they occur at low density or high densities within a stand. Large diameter fire tolerant species can survive low to moderate fire, contributing to the recovery of the forest after disturbance and to the long term forest structural diversity. They provide important wildlife habitat features, both as live trees and when they die as snags and downed wood, which provides denning habitat for lynx and a variety of other species. They occur within old growth forest, as well as provide opportunity for development of future late successional or old growth forest. They can be of higher economic value as wood products.

Western larch and ponderosa pine are highly valued large diameter tree species in the ecosystems of the Forest, because of their ability to fill all of these roles. The decay and snag traits of these species are conducive to cavity formation and long-term snag persistence. Douglas-fir and western white pine also have relatively high value, being long lived and somewhat tolerant of fire. Large Engelmann spruce is long lived and contributes to late successional forest structures, but is intolerant of fire, more susceptible to insect and disease, and less persistent as a snag. Refer also to the wildlife chapter in this EIS for additional information on wildlife associated with very large live trees.

The very large forest size classes (described earlier) indicates areas where trees >=20 inches d.b.h. occur in relative abundance. However, because forest size class is based on the average diameter of trees across the stand, it does not provide the full picture of the amount or distribution of very large live trees across the Forest. The very large tree subclass described here is the indicator that will be used in this analysis to identify not only where these very large diameter trees occur in abundance, but also where they occur at lower densities. It is referred to as a subclass, because it defines areas that may be classified into any of the five forest size classes described earlier, but where very large live trees occur at certain minimum densities. Tree density criteria and existing proportion of the very large tree subclass across the landscape are displayed in Table 15 below. Current density in trees per acre of the very large trees within each biophysical setting are displayed in Table 16. The source of the data for existing condition is FIA data using R1 Summary database (Hybrid 2011) analysis tools. The current proportion from this dataset is expressed as an estimated mean percent, with a lower and upper bound estimate provided at a 90% confidence interval.

Table 14. Very large tree subclass definitions and current estimated percent, forestwide and by biophysical settings

Biophysical setting	Very large tree subclass tree density criteria	Current estimated percent
Forestwide	Incorporates the criteria specific to each biophysical setting	14.1 (11.9-16.5)
Warm Dry	At least 8 trees per acre greater than or equal to 20 in. d.b.h.	18.9 (11.6-27)
Warm Moist	At least 10 trees per acre greater than or equal to 20 in. d.b.h.	11.5 (2.5-22)
Cool Moist-Mod Dry	At least 10 trees per acre greater than or equal to 20 in. d.b.h.	14.5 (11.8-17.4)
Cold	At least 10 trees per acre greater than or equal to 15 in. d.b.h.	9.2 (4.0-15.2)

Table 15. Current estimated density as measured by trees per acre, for very large live trees across Forest lands, by biophysical setting.

Biophysical setting	Current estimated trees per acre	Current predominant species of very large live trees
Forestwide	4.2 (3.5-5.0)	Douglas-fir, western larch, spruce
Warm Dry	5.4 (3.0-8.4)	Douglas-fir
Warm Moist	3.3 (1.0-6.4)	Douglas-fir
Cool Moist-Mod Dry	4.2 (3.4-5.1)	Western larch, Douglas-fir
Cold	2.3 (0.9-3.9)	Spruce

As is evident in the tables, there is about two and one half times the area where very large live trees are present forestwide than there are acres in the very large forest size class. This directly reflects the adaptations native tree species have to survive and persist under a fire-dominated disturbance regime, as described in the species descriptions in the vegetation composition section earlier. These very large live trees will be scattered irregularly across the landscape.

The desired condition is to maintain or increase the area and/or density of the very large live tree component. The desired species of very large trees are western larch and ponderosa pine in the warm dry and warm moist biophysical settings, with the addition of western white pine and western red cedar in the warm moist setting. For all forest size classes, there is an expectation that there will be wide fluctuation over the short and long term, because of the complex inter-relationships between ecological processes (such as succession) and disturbances (such as fire), and the influence of other resource desired conditions and objectives.

Environmental consequences

Effects of alternative A

A key difference of this alternative when compared to the action alternatives is related to the forest plan direction associated with both forest size classes and the very large tree component. The 1986 Plan does not explicitly describe desired conditions for forest size classes and very little if any specific direction related to forest size classes or to very large tree components. It does incorporate an ecologically-based approach to management of vegetation, including managing for vegetation composition, structures and patterns that would be expected to occur under natural succession and disturbance regimes; reducing the risk of undesirable fire, insect and pathogen disturbances; and providing for long-term recruitment of forest structural elements such as snags and downed wood. General direction to manage for old growth or late seral stages is provided, which indirectly relates to the presence of very large live trees. Most of this direction is located in the forest-wide objectives under section A(6)-Vegetation (pg. II-8, 1986 Forest Plan) and forest-wide standards under (H)-Vegetation (pg. II-47, 1986 Forest Plan).

Effects common to alternatives B, C, and D

The revised forest plan for all action alternatives include specific plan components related to condition of forest size classes that will contribute to biodiversity and ecological integrity of the Forest (FW-DC-TE&V-12). This direction provides substantially more detail and clarity as to what desired conditions are for forest size classes, that is based on analysis of NRV and natural disturbances and,, to the best of our knowledge, will maintain or trend the forest towards forest resilience and sustainability. Forest Plan components emphasize maintenance and development of very large trees – a key ecosystem component (FW-DC-TE&V-13; FW-GDL-TE&V-11). Objectives in the revised plan specify acres of treatments to achieve desired conditions, emphasizing the importance of active management in maintaining or achieve these conditions.

In contrast to the existing plan, in the revised plan desired conditions for certain key ecosystem components are developed in a manner whereby reliable and repeatable monitoring of existing conditions and trends over time is possible, and the monitoring plan reflects this. Measurable monitoring components are important for determining how management activities and ecological processes, including climate change, may be influencing vegetation conditions and achievement of desired conditions over time.

Modeled comparison of alternatives for forest size class

All alternatives show a similar and desirable upward trend forestwide in the **seedling/sapling size class**. The increase and persistence of the seedling/sapling size class indicates that moderate and high severity fire (mostly wildfire but also prescribed fire), remains a main driver into the future across the Forest, though not at levels outside the desired condition (refer to Fire and Fuels Management section of this EIS for discussion of future fire). The largest increase in seedling/sapling size class occurs in the cold biophysical setting, with all alternatives showing the amount of this size class near the maximum desired level by the fifth decade. This appears to reflect greater amounts of stand replacing fire in this setting, which is likely due to the changes in species composition and warming climates.

In the warm dry and cool moist moderately dry biophysical settings, the amount of seedling/sapling size class at the fifth decade of the modeling period remains near the current level, though alternatives B and D indicate there could be a trend upwards in this size class, mainly in the warm dry setting. In all cases, proportions remain within desired ranges, though at the low end for the cool moist-mod dry setting. Regeneration harvest accounts for some of the seedling/sapling size class in the warm dry, but fire (wildfire and prescribed fire) is likely the primary process maintaining and creating this size class in both settings.

Contrary to the forestwide trend, seedling/sapling size class decreases by the fifth decade in the warm moist biophysical setting under all alternatives, to the minimum desired condition. Low amounts of stand replacement wildfire, and insufficient amount of regeneration harvest, are likely responsible for this. Fire suppression is generally more effective in the lower elevation and more easily accessed areas where these sites occur. A higher proportion of low to moderate severity fire may occur in this setting, including prescribed burns, and these fires would leave more live trees and create less area dominated by seedling/saplings.

The **small size class** decreases and the **medium size class** increases by the fifth decade in all alternatives and all biophysical settings. The proportions of these size classes fluctuate widely over the five decade modeling period, shifting as forests advance into larger size classes through succession or are affected by disturbances that return them to smaller size classes. The decrease in small size class is favorable, and it remains or moves down into the desired range in nearly all cases. The increase in medium size class is generally unfavorable, increasing levels to above desired conditions both forestwide and in the warm moist and cool moist mod dry biophysical settings. This increase is due both to succession of small size classes into medium sizes and loss of the larger trees within stands of large and very large size classes due to disturbances (such as insect and disease).

The **large tree size class** trends steadily upward over the five decade modeling period under all alternatives, forestwide and in all biophysical settings except the warm dry setting. Successional transition likely accounts for much of this increase, though some may be attributed to the decline of the very large tree size class through mortality of the very large trees. Desired levels of large tree size class appear to be reached in some settings by the fifth decade (the warm moist and cold settings) and should be achieved forestwide if the trend continues past the fifth decade.

The **very large tree size** class trends steadily downward over the five decade modeling period under all alternatives, forestwide and in all biophysical settings except the warm dry setting. In most cases, it decreases to at or just below the minimum desired range. Much of this decrease is likely attributable to high amount of both Douglas-fir and spruce beetle portrayed in the model, both of which would cause widespread mortality of trees in the very large size classes and revert forests back to a smaller size class (refer to section 3.2.1, modeled disturbance processes). Other factors would be loss due to wildfire, which also increases over the five decade model period, and the slow rate of succession of smaller forest size classes into the very large size class relative to a five decade model period.

As modeled, the warm dry biophysical setting shows a distinctly different trend in the large and very large size classes when compared to other settings. Large size class decreases and the very large size class increases under all alternatives. The large size class is at or below the desired minimum, and the very large size class moves to well within the desired range. Lower severity prescribed fire likely plays a major role in promoting the development of very large tree size class, as it removes the smaller diameter understory trees (mainly Douglas-fir) and preserves larger diameter overstory trees (mainly ponderosa pine). Commercial thinning may also be influencing this increase in very large size class as well. The decrease in large tree size class may be partly attributable to Douglas-fir beetle and mortality of large trees. Wildfire is responsible for some decrease, and to a lesser degree timber harvest.

3.3.6 Forest Density

Affected environment

Forest density is a measure of the area occupied by trees. The density of trees can influence the growth and vigor of individual trees in a forest stand, and the susceptibility of the trees to drought, insects and diseases, wildfires, and other disturbance events. It can influence the rate of forest succession and the composition of other plant species in the community. These factors in turn affect whether or not the stand is suitable habitat for certain wildlife species.

Tree density can be described quantitatively in various ways, such as number of trees or basal area per acre. At the forest-level scale of analysis, using existing vegetation databases and to facilitate analysis of natural range of variability, tree canopy cover is used as a means to assess forest density. Tree canopy cover is defined as the percentage of ground covered by a vertical projection of the outermost perimeter of the tree crowns, considering trees of all heights.

Canopy cover is typically low when the stand is in the earliest stage of succession and dominated by seedling trees. As trees grow, crowns expand to fill up the growing space, and canopy cover gradually becomes greater. Growth of understory trees over time also adds to the canopy cover on many sites, especially as the forest grows into the later successional stages. Site productivity also affects canopy cover, with more productive, moist sites tend to support higher canopy cover, and harsh sites with poor soils supporting lower canopy cover.

Four canopy cover classes are defined based on percentage of area covered by tree crowns: **Very low** = less than 15% tree canopy cover; **Low** = 15 to 40% tree canopy cover; **Moderate** = 41 to 60% tree canopy cover; and **High** = greater than 60% tree canopy cover. Evaluation of natural range of variability for canopy cover was completed using the SIMPPLLE model, as well as consideration of historical fire regimes and disturbance patterns as they might have influenced forest density on the Flathead Forest. A summary of this analysis follows. Refer to exhibits in the planning record for greater detail.

The relatively moist conditions across most of the Flathead Forest has the potential to support forests fully occupied by trees. Forests in the very low canopy cover class were historically the least common type, occupying less than 10% of the Flathead, and likely found mostly in forests at the earliest stages of succession, or on harsh (very dry or very cold) growing sites. The low canopy cover class, however, was relatively common forestwide, and may have occupied up to 45% of the forested area. It was especially abundant on the warm dry biophysical setting, reflecting the relatively more frequent fires of low to moderate severity that would occur in these forests, thinning the forest, and the predominance of fire tolerant species on these sites (e.g., ponderosa pine). Many forests on the cool moist sites also were low canopy cover class, likely forests in their early and mid-successional stages, and older forests as various disturbances begin to remove trees (such as insects, windthrow) and open up the canopy layer.

Moderate canopy cover is the most common forest density forestwide, occupying up to 50% of the Forest area. High canopy forests also were abundant, occupying up to 45% of the area forestwide. These two canopy cover classes were especially abundant in the warm moist biophysical setting, reflecting the higher site productivity. The high canopy cover forests were relatively rare on the cold biophysical setting, occupying less than 15% of the area. This was likely due to the low site productivity of these higher elevation lands.

Figure 28 to figure 32 display the current estimated area on Forest lands that are in the different canopy cover classes, forestwide and by biophysical setting. For all the figures and tables in this section, the source of the data for existing vegetation is FIA data using R1 Summary database (Hybrid 2011) analysis tools. The current proportion from this dataset is expressed as an estimated mean percent, with a lower and upper bound estimate provided at a 90% confidence interval.

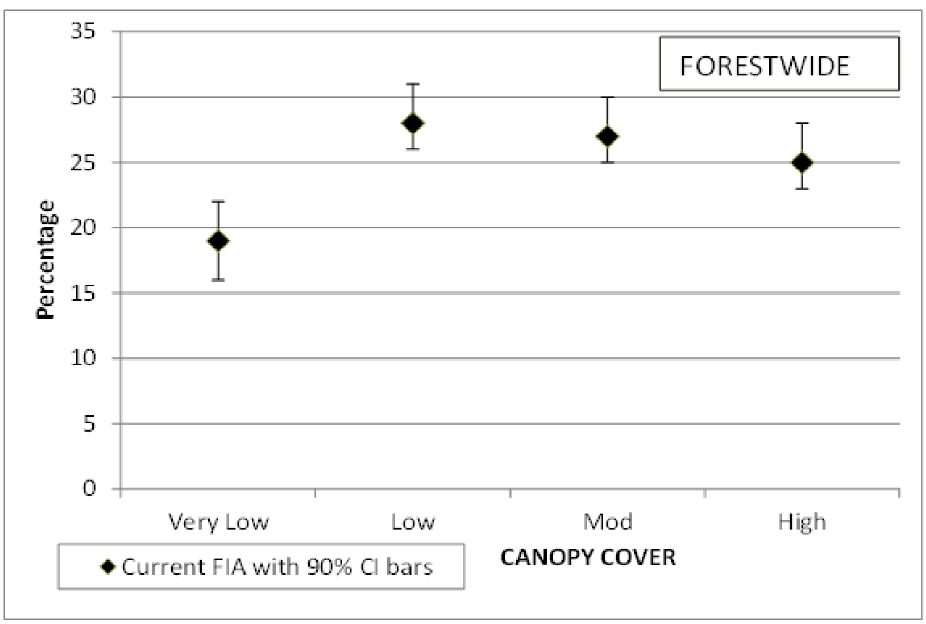


Figure 28. Current percent of area by forest canopy cover class, forestwide.

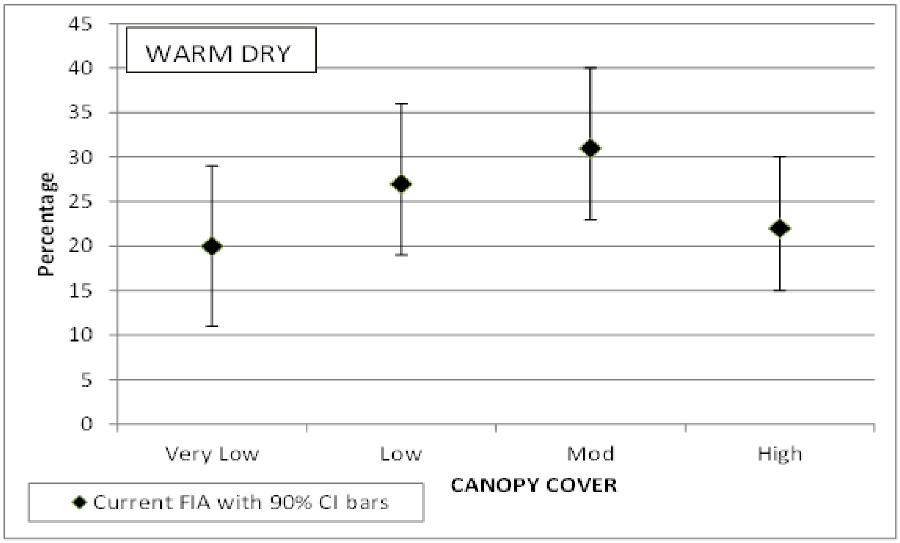


Figure 29. Current percent of area by forest canopy cover class in the warm dry biophysical setting.

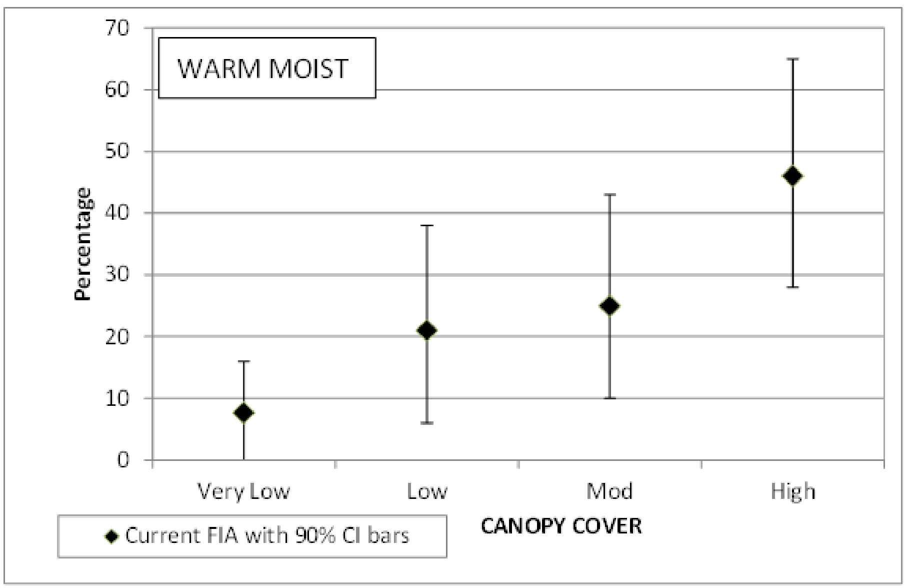


Figure 30. Current percent of area by forest canopy cover class in the warm moist biophysical setting.

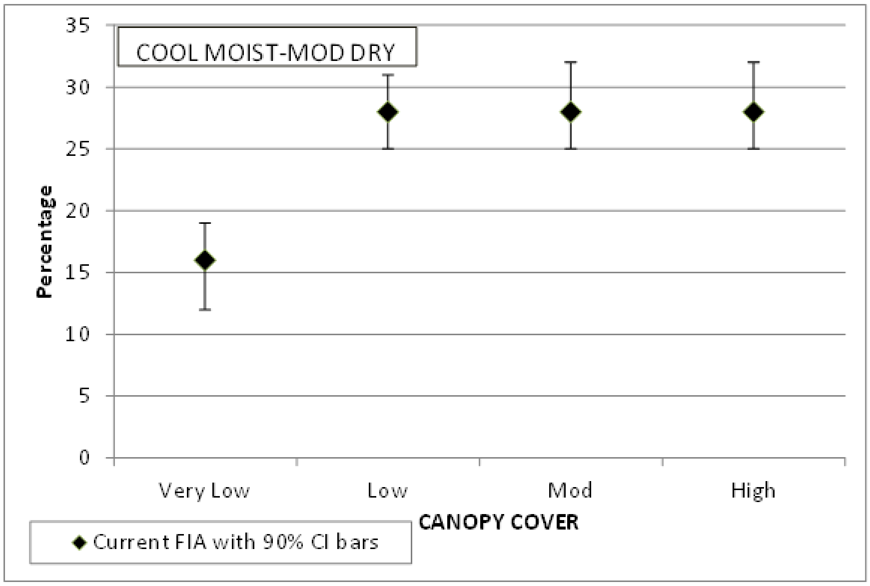


Figure 31. Current percent of area by forest canopy cover class in the cool moist-moderately dry biophysical setting.

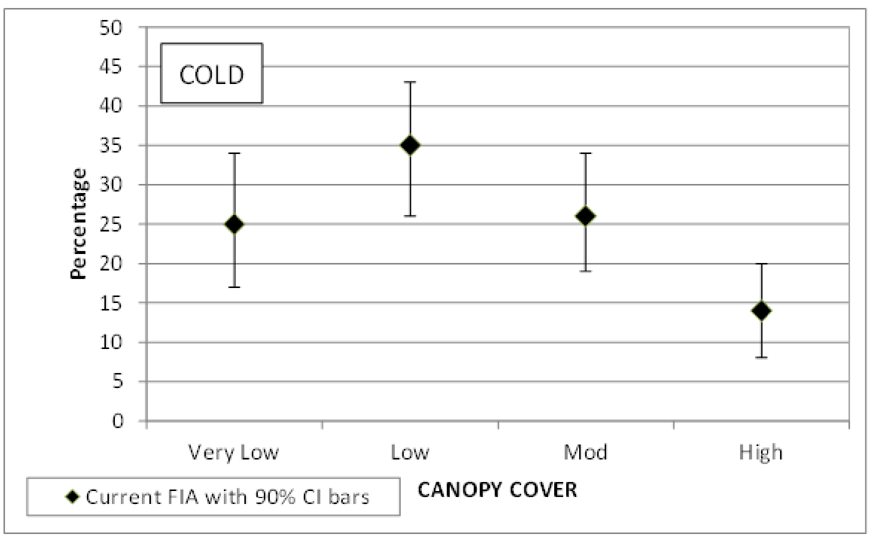


Figure 32. Current percent of area by forest canopy cover class in the cold biophysical setting.

Current forest densities are generally at levels that are within the range of natural variation, with most of the forest showing fairly similar amounts of forest distributed between the low, moderate and high canopy cover classes. It is desirable for forest stands to be at densities that contribute to desired ecological, social and economic conditions. Forest density conditions influence wildlife habitat (e.g., important cover and foraging conditions for many species, including Canada lynx), forest resilience (reduced competition, increased tree vigor, development of very large trees), timber productivity (moderate densities for improved growth), and fire hazard (e.g. reduced fuels in wildland urban interface). Table 16 displays the desired condition for forest density.

Table 16. Desired and current conditions forestwide and by biophysical setting for forest density as measured by canopy cover.

Area	Forest density class[a]	Current estimate % area[b]	Desired trend
Forest wide	Very low to Low Moderate to High	47 (44-51) 53 (49-56)	Maintain minimum 35% of forest area in lower density category (<40% canopy cover). Decreasing trend in highest density forests (i.e., >60% canopy cover) in areas where this contributes to other desired conditions (i.e., fuel reduction, increased forest resilience, timber productivity).
Warm-Dry	Very low to Low Moderate to High	47 (36-57) 53 (43-64)	Decrease higher density forests (i.e., >60% canopy cover), and maintain a minimum 40% of area in lower densities (e.g., 15-40% canopy cover)
Warm-Moist	Very low to Low Moderate to High	29 (11-47) 71 (52-88)	Maintain minimum 50% of area at moderate and higher densities (i.e., >40% canopy cover), except in portions of the wildland urban interface, where lower densities would be most common (e.g., 15-40%).
Cool-Moist/Mod Dry	Very low to Low Moderate to High	44 (39-48) 56 (52-60)	Maintain minimum 55% of area at moderate and higher densities (i.e., >40% canopy cover), except in portions of the wildland urban interface, where lower densities would be more common (i.e., <40% canopy cover).
Cold	Very low to Low Moderate to High	60 (50-69) 40 (31-50)	Decrease high density forests (i.e., >60% canopy cover) to moderate and low density (i.e., <60% canopy cover).

a. Canopy cover considering trees of all size classes. Very low <15%; Low 15 to 39%; Moderate 40-60%; High >60%

b. Percent of NFS lands. Data source: R1 Summary Data Base, FIA Hybrid 2011 dataset. Lower and upper bounds at 90% confidence level.

There are several ecological concerns associated with conditions or trends away from desired conditions for forest density. In general, the denser the forest the greater the likelihood that fuel characteristics could support a fast moving intense crown fire. This is not only a result of greater fuel quantities in a dense forest, but also of the vertical and horizontal continuity of fuels. Within wildland urban interface areas in particular, lower forest densities are desired.

The susceptibility of a forest to insects and diseases is heavily influenced by density and its impact on tree vigor. As the density increases, a deficit of soil moisture develops and trees lose their ability to withstand attacks by insects, pathogens, and parasites (Powell 1999, Safranyik et al. 1998). Density-related tree mortality from insects, diseases, and competition leads to increased dead fuel quantities and higher fuel hazards.

Forest density influences tree species composition as well. Western larch and ponderosa pine are intolerant of shade and cannot survive in the lower canopy layers. Shade tolerant species, such as subalpine fir, grand fir and spruce can prosper in dense stand conditions with limited light. Unless a disturbance (such as fire) reduces competition from these shade tolerant species, species such as western larch and ponderosa pine will die out.

Environmental consequences

Effects of alternative A

The 1986 Plan does not explicitly describe desired conditions for forest density or direction to manage for any particular forest density conditions. The existing plan does incorporate an ecologically-based approach to management of vegetation, including managing for vegetation composition, structures and patterns that would be expected to occur under natural succession and disturbance regimes and reducing the risk of undesirable fire, insect and pathogen disturbances. Managing forest density could be one of the means to achieve this direction.

Effects common to alternatives B, C, and D

The revised forest plan for all action alternatives include specific plan components related to condition of forest density that will contribute to biodiversity and resilience of the Forest (FW-DC-TE&V-14). This direction provides substantially more detail and clarity as to what desired conditions are for forest densities that to the best of our knowledge, will maintain or trend the forest towards forest resilience, as well as meet social and economic needs. Objectives in the revised plan specify acres of treatments to achieve desired conditions, emphasizing the importance of active management in maintaining or achieve these conditions.

In contrast to the existing plan, in the revised plan desired conditions for certain key ecosystem components are developed in a manner whereby reliable and repeatable monitoring of existing conditions and trends over time is possible, and the monitoring plan reflects this. Measurable monitoring components are important for determining how management activities and ecological processes, including climate change, may be influencing vegetation conditions and achievement of desired conditions over time.

Modeled comparison of alternatives for forest density

Over the five decade modeling period, the area of forest in low to moderate canopy cover (15-60%) increases in all alternatives, with a proportionate decrease in the high (>60%) canopy cover class, with all alternatives showing the same trend and similar degree of change. The very low canopy cover class (<15%) shows a small increase in all the action alternatives, and a small decrease in alternative A. By the end of the fifth decade, there is about 60% of the forest in low/very low canopy cover classes, and 30% in moderate to high canopy cover. Though the action alternatives are very similar in the amount of change, alternative C has a slightly greater increase in low/very low and respective decrease in mod/high when compared to the other alternatives.

Within the biophysical settings, the warm dry setting shows a substantial increase in all alternatives of both the very low and low canopy cover, with most of the change coming from the high density stands, which decrease to a very low level. This indicates highly desirable trends for this setting, where lower stand densities overall are desired. A similar trend in canopy cover classes occurs in the warm moist and cool moist-mod dry settings, though somewhat less substantial changes. Tree mortality caused by insects, disease and fire may account for much of the decrease in forest density, as well as commercial thinning. Alternatives B and C both tend to have the greatest increases in the lower canopy cover classes over time in all these settings. In all alternatives and settings (except for the cold biophysical setting), the increase of insect and disease activity at the 3rd decade of the modeling period appears to be responsible for the drop in in high canopy cover forests at that time and their transition into the moderate or even low canopy cover classes.

3.3.7 Old Growth Forest

Affected environment

Old growth forest is a forest structural condition that may develop during the late successional stage of forest development. This section describes and discusses the characteristics, development and condition of old growth forest, as characterized by specific structural attributes and conditions for the sites on the Flathead National Forest, published in Green et al. (1992 with 2011 errata). Hereafter, in this section of the EIS, the term "old growth" will refer specifically to stands that meet the definitions in this publication. Old growth is of particular value to many wildlife species, including several at-risk species. The wildlife section of this EIS discusses old growth forest and associated stand characteristics in relation to habitat values (e.g., old growth habitat).

Old growth, like all forest conditions, is dynamic, with stands moving into and out of old growth conditions and the proportion and distribution of old growth across the landscape changing naturally over time. Though all old growth is late successional forest, not all late successional forest qualifies as old growth. Old growth must meet specific attributes to qualify. The Forest has adopted the definitions of old growth developed by the Regional Old Growth Task Force and documented in Green et al. 1992 (as corrected by errata in December of 2011). The definitions are specific to forest type (dominant tree species) and habitat type group. Key attributes for identification of old growth are age, numbers and diameter of the old tree component within the stand, and the overall stand density. Minimum thresholds have been established for these attributes. For example, the most common old growth type on the Forest requires at least ten trees per acre that are at least 180 years in age and 21 inches in diameter, with a minimum stand density of 80 square feet basal area. Associated characteristics are also defined for each old growth type, though these are not minimum criteria. They include such factors as probabilities of downed woody material and number of snags, number of canopy layers, and number of snags over 9 inches d.b.h.

From an early successional seedling stage, on the sites typical of the Flathead Forest it could be expected to take at least 150 years for a forest to develop into old growth conditions. As discussed in the assessment and in the Fire and Fuels section of this EIS, periodic fire, and stand replacement fire in particular, is a major disturbance process in this ecosystem, with historical fire frequencies from 35 to 100 or more years. The likelihood of a particular forest stand to experience wildfire within 100 to 150 years would be high across most of the forest. Thus, it is the long-lived, early successional, fire tolerant tree species that play a particularly critical role in the successional process and development of old growth forests on the Flathead. They are the trees that have a chance of surviving moderate and even high severity fires, as well as have adaptations that enable them to regenerate and grow rapidly in the burned forest conditions (refer to earlier discussion of species characteristics in the Vegetation Composition section). These species include western larch, ponderosa pine, western white pine, as well as Douglas-fir and whitebark pine on some sites. Individual trees of these species can persist on some sites well into the late successional stages. They become the large diameter, old trees that are key features of the old growth forest condition. See also discussions under the forest size class and very large tree sections earlier.

Current condition

Field inventories are necessary to accurately determine amount of old growth forests, because of the specific forest conditions required to qualify as old growth. Associated characteristics that influence the quality of the old growth, such as snags and downed wood, also require field inventory to adequately assess. It is infeasible to maintain an inventory that covers every acre within a large analysis area, such as a national forest, for purposes of determining the amount and location of old growth. This type of inventory more appropriately occurs at the project level, where site specific analysis and accurate identification of old growth may be necessary to conduct the proposed management actions. Some of the old growth on the Forest has been mapped during project level analysis, but the vast majority has not.

FIA field procedures collect tree d.b.h. and measure age so can be used to assess old growth amounts, and thus provides a statistically sound estimate of the amount of old growth across the forest (refer to Information Sources section). Summarizing FIA data across analysis units within the forest boundary provides information on the amount and the distribution of old growth across the Flathead.

Figure 33 displays the summary of old growth acres on the Forest as derived from FIA inventory data (subplots that were affected by fire were removed from calculations). Following the table is a discussion and description of old growth characteristics on the Forest.

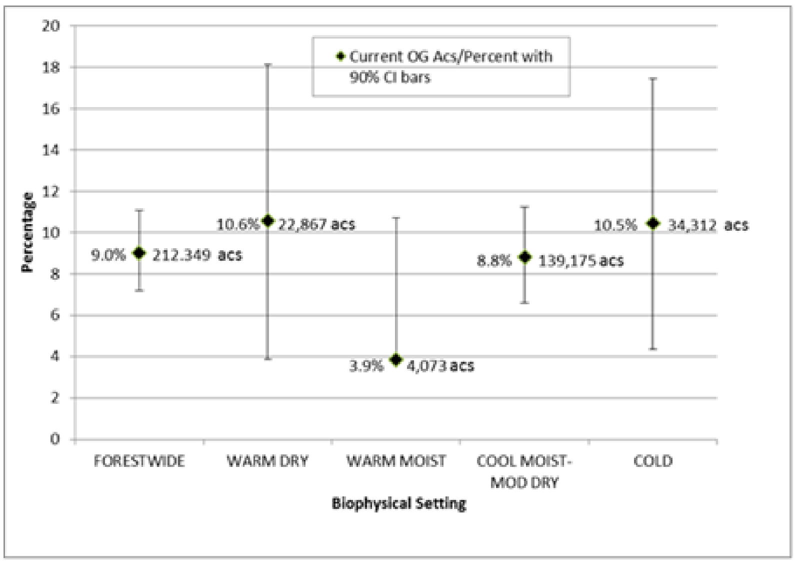


Figure 33. Current estimated acres and percent of old growth forestwide and by biophysical setting, on NFS lands.

Data source: FIA data using R1 Summary database (Hybrid 2011) analysis tools. Current proportion expressed as an estimated mean percent, with a lower and upper bound estimate provided at a 90% confidence interval.

A large amount of area (over 350,000 acres) has burned across Forest lands over the past 15 years (refer to Fire and Fuels section). These fires are the primary reason for the loss of approximately 2.9% of the old growth (approximately 57,400 acres) on the Forest over that time period (source: R1 Summary database, comparison Hybrid 2011 dataset with previous version, Hybrid 2007; refer to planning record). No old growth on the Forest has been removed through harvest treatments for at least 15 years (the current forest plan prohibits removal of old growth through harvesting).

Other factors that influence the current amount and distribution of old growth are the long-lasting effects of large wildfire in the late 1890s and early 1900s, and harvest activities over the past 65 years. In addition, old growth that may have existed on non-national forest lands within the planning area has largely been removed over the past 100 years or so through harvest or conversion of lands to other uses, such as agriculture. The average size of remaining old growth patches on all land ownerships are likely less than they were in the more recent past, particularly in areas where large patches were fragmented by harvest or development patterns. On the other hand, natural succession has likely resulted in the transition of other stands into old growth conditions.

Old growth conditions vary depending on the site capabilities (e.g., biophysical setting) and on other factors unique to the site, such as disturbance history. Description of typical old growth conditions are found in the aforementioned regional old growth publication (Green et al 1992 with errata). Brief descriptions of a typical species composition and forest structure in existing old growth on the Forest follows below.

Old growth conditions on the warm-dry biophysical setting contain large diameter, old overstory Douglas-fir and ponderosa pine, with minor amounts of western larch on some sites. On most of the areas within this setting, there are at least eight trees per acre greater than 21 inches d.b.h. and greater than 170 years old. A relatively open overstory canopy exists, but Douglas-fir can often be dense in the mid and understory canopy layers – a condition resulting from lack of disturbance which would thin out the smaller diameter Douglas-fir. When this more dense condition occurs, the large, older Douglas-fir and ponderosa pine become more susceptible to Douglas-fir beetle or western pine beetle-caused mortality, respectively, thereby possibly changing old-growth characteristics.

Old growth on the warm moist settings have the widest range of species that may comprise the overstory tree layer, including western larch, Douglas-fir, western white pine, ponderosa pine, Engelmann spruce and western redcedar. At least ten trees per acre greater than 21 inches d.b.h. and greater than 180 years old occur. Forests are typically dense, multi-canopy, with understory tree layers mostly composed of the more shade tolerant species, such as grand fir, cedar and Douglas-fir. Subalpine fir and spruce also may occur in the understory layers.

Western larch, Douglas-fir and Engelmann spruce are the dominant large diameter, old trees within old growth forests on the cool moist/mod dry settings. At least ten trees per acre of old trees (minimum 180 years) occur, with minimum size of the old trees ranging from 17 inches d.b.h. on the drier sites to 20 inches d.b.h. on the moist sites. Forests are typically dense, with multi-canopy layers, with subalpine fir and spruce the most common mid and understory tree species.

Engelmann spruce and subalpine fir are the most common large, old overstory tree in old growth forests on the cold biophysical settings, though in a few rare situations there may still be a few scattered, large old whitebark pine present (that haven't yet been killed by blister rust or bark beetles). Because of the cold, harsh growing conditions, tree growth is slower and old trees are smaller than in old growth forests at lower elevations. Old growth in these cold settings have a minimum of ten trees per acre greater than 13 inches d.b.h. and greater than 180 years old. They are typically multi-canopy layers, though overall tree density may be low. Subalpine fir and spruce dominate in the mid and lower canopy layers.

Existing old growth on the Forest is vulnerable to loss due to moderate or high severity fire, as well as impacts from insects and disease. Fire exclusion and suppression, particularly in the lower elevation warmer sites, have altered vegetation structure and composition in some of the remaining old growth forests on the Forest. In the absence of fire, insects and diseases are responsible for about 75% of changes in vegetation trends (Hagle and Byler 2000). Increasing tree densities, canopy layers, and proportions of Douglas-fir in many areas have increased tree stress and vulnerability to mortality from insects, pathogens, and high intensity crown fires.

Environmental consequences

Effects common to all alternatives

All alternatives have forest plan direction for old growth management focuses on the maintenance and protection of existing old growth across the landscape and managing for desired old growth amounts and patterns into the future, especially on the warm dry biophysical setting. This direction has been in place on the Flathead since the late 1990s, with the completion of Amendment 21 for the current forest plan. The revised plan integrates and is consistent with existing plan direction for management of old growth. A comparison and discussion of management direction for old growth between the existing plan and the revised plan alternatives is provided in table 18.

Table 17. Comparison and discussion of different forest plan components by alternative for old growth.

	Existing plan-alternative A	Revised plan[2] alternatives B, C and D
Protection of existing old growth	"Protect old growth, consistent with vegetation standard H(6)."[1] Vegetation standard H(6) states "Maintain or restore existing old growth consistent with Wildlife and Fish objectives and standards."[2] and (b) limits vegetation mgmt. within old growth to actions that would maintain or restore composition and structure consistent with native disturbance regimes; or actions that would reduce risks to sustaining old growth. Provides exception to vegetation standard H(6) stating that the standard "does not apply to personal-use firewood permits; tree removal to protect health and safety in administrative and recreational special use areas; tree removal necessary for trail or trailhead construction; or legally required private land access."[2]	Standard FW-STD-TE&V-02 addresses old growth conditions specifically, and is consistent with the direction in the existing plan. "In old growth forest, vegetation management activities must not modify the characteristics of the stand to the extent that the stand would no longer meet the definition for old growth" "Vegetation management within old growth shall be limited to actions that: (1) maintain or restore old growth habitat characteristics and ecosystem processes; (2) increase old growth forest resistance and resilience to disturbances or stressors that may have negative impacts on old growth characteristics (such as drought, high severity fire, bark beetle infestations); (3) reduce fuel hazards adjacent to private property or other exceptional values at risk; or (4) address human safety."
Protection of existing old growth	"Road construction associated with vegetation management shall avoid or minimize impacts to old growth to the extent feasible."[2]	FW-GDL-TE&V-08. "Building of new roads should avoid impacts to old growth where feasible."
Old growth management at the stand-level	Forest wide objectives for vegetation[3], at the stand-level, providing extensive guidance on managing for desired late seral/old growth forest compositions and structures within each potential vegetation type.	The revised plan integrates these same concepts into numerous desired condition for forest structures and compositions, both forestwide and within biophysical settings (i.e., PVGs). These include DCs for forest composition, size classes, large tree size class, old growth, forest density, snags and downed wood, landscape pattern and ecosystem processes (insects, disease, fire).[6] FW-DC-TE&V-15 provides desired conditions specifically for old growth composition, structure and pattern, forestwide and by biophysical setting.
Management of old growth at the landscape-level and over time	Forest wide goals[4] and objectives[5] for vegetation at the landscape-level specifies managing landscapes to "attain the 75% range around the median amount of old growth that occurred historically" and to	As discussed below under Effects common to alternatives B, C, and D, no historical range of variation or quantitative desired conditions are provided specifically for old growth forest. FW-DC-TE&V-15 provides qualitative desired

	Existing plan-alternative A	Revised plan[2] alternatives B, C and D
	"actively manage to recruit additional old growth." Further guidance is provided in the objective to "manage landscape patterns to develop larger old growth patch sizes where needed"; "restore the amount and distribution of old growth forests to within the historical range of variability"; "prescribe landscape treatments that protect old growth forests from disturbances that threaten old growth composition and structure". Treatments within existing old growth "may be appropriate where current insect and disease conditions pose a major and immediate threat to other stands."	conditions for old growth habitat at the stand and landscape level. Forest plan components for very large tree class and very large live trees correlate closely to structural conditions desirable in old growth forest and old growth habitat (FW-DC-TE&V-11, 12, 13; FW-GDL-TE&V-11). Quantitative and qualitative desired conditions for these plan components are provided, based on analysis of the natural (i.e., historical) range of variation, and would contribute to development of old growth habitat.. FW-GDL-TE&V-07: "Where feasible and consistent with other resource management direction, landscape patterns and vegetation conditions should be managed to: 1) increase the resilience of old growth forest to potential future disturbance which may result in loss of old growth characteristics (e.g. high severity wildfire or epidemic insect outbreaks); 2) increase the size and shape of old growth forest patches so that there are portions 300 feet or more from early successional forest edge; and 3) promote the long-term (i.e., beyond the plan period) development of future old growth forests and old growth habitat or forests with key characteristics of old growth (refer to appendix C for guidance and examples to achieve this guideline)." See also Old growth management at the stand level earlier.

1. Forest-Wide Standards, F(4) Wildlife and Fish - Old growth and cavity-dependent species, pg. II-35.
2. Forest-Wide Standards, H(6). Vegetation – old growth, pg. II-48.
3. Forest-Wide Objectives, 6(c). Vegetation - Forest Composition and Structure. Stand level direction for Late Seral/Old growth, pg. II-10.
4. Forest-Wide Resource Goals B(10). Old Growth, pg. II-5.
5. Forest-Wide Objectives, 6(c). Vegetation - Forest Composition and Structure. Landscape level direction, pg II-9.
6. FW-DC-TE&V-DC 03, 08 through 24.

This direction would provide a high level of protection to existing old growth in all alternatives, as well as recognizing the importance of old growth development over time.

Effects common to alternatives B, C, and D

It is difficult if not impossible to determine quantitatively the natural range in variation in old growth forest as currently defined across the landscape, because of the specific stand characteristics required to classify as old growth. For this reason, the action alternatives do not include the goal currently in the existing plan to manage for old growth at "75% range around the median of the historical range of variability" and do not frame the old growth desired condition as a quantitative range based on NRV. However, analysis of natural range of variation and conditions of the very large forest size class would correlate closely with old growth forest, or at the least these stands would likely contain the large tree characteristics associated with old growth. As indicated in figure 23 to figure 27, the current estimated proportion of very large forest size class is lower than the current estimate of old growth in figure 34, both forest wide and for the biophysical settings (except in the cold setting). As discussed in affected environment, though old growth forest would have a very large tree component, it is not necessarily dominated by trees in the very large size class. Additional old growth could occur within forests in the medium or large forest size classes, which may contain structural characteristics and sufficient trees >=20 inches d.b.h. to qualify as old growth forest. Consideration of the condition for the very large tree subclass (Table 15 and Table 16) provides additional information for assessing forests that contain old growth characteristics. The values for the very large tree subclass are consistently above the current estimated amount of old growth. Though not all forests in the very large tree subclass meet the specific old growth forest conditions, they are the likely areas that contain some of the important features of old growth, such as large trees and diverse forest structures. Refer to the Wildlife section of this EIS, in the section discussing old growth associated species, for additional information.

All action alternatives contain a forest plan standard that states no vegetation management activities should modify the characteristics of old growth such that the stand would no longer meet the definition for old growth (FW-STD-TE&V-02). Therefore, no loss of old growth should occur under the action alternatives due to harvest activity.

Desired conditions in the revised forest plan under all action alternatives more fully recognize the dynamic nature of old growth forest over time, and the desire to increase resilience of old growth, and the size and shape of old growth patches (FW-GDL-TE&V-07). Qualitative descriptions of desired old growth conditions are also provided (FW-DC-TE&V-15), including species mixes and structures desired for old growth forest within the different biophysical settings.

Modeling results suggest that there would be a downward trend over the next five decades in the very large forest size class in all biophysical settings except the warm dry (refer to Forest Size Class section). All action alternatives have forest plan direction that provides for retention of larger diameter live trees and other key stand structural components that would contribute to future old growth development within harvest units (FW-STD-TE&V-04; FW-GDL-TE&V-09, 10, 11, 12). These include retention of large, live trees within vegetation treatment units; placing more emphasis on leaving the larger snags and live trees with decay; and focusing on stand conditions that would make old growth forests more resilient in a changing climate. Actively managing stands to develop future old growth forest conditions is particularly emphasized in the action alternatives, specifically in FW-GDL-TE&V-11. Direction for retention of live trees within harvest units for a variety of reasons, including future old growth development, is provided in this guideline. As explained in Appendix C, this management could include thinning in young sapling stands to develop future species composition, size classes, and stand structures characteristic of late successional and old growth forests. It could also include treatment in small or medium forest size class stands to retain larger or more rapidly growing overstory trees, patches of younger trees, and other stand components and structures that could contribute to future old growth forest conditions.

In all alternatives, however, fire and other natural disturbances will continue to influence this landscape substantially more than vegetation treatments, and will remain the main reason by far for loss of old growth forest. Succession will continue to be the primary means by which old growth forest is formed. Vegetation treatments that promoting the long-term development of old growth over the long term (such as commercial and non-commercial thinning in young stands that promote rapid tree growth) and the retention of large, live trees within harvest units, are key management tool that would promote old growth development. They are available as management tools over a small portion of the Forest (see Table 13). Old growth amounts and distribution will remain highly dynamic and variable over time, as it has been historically.

3.3.8 Snags and Downed Wood

Dead wood in the forest occurs both as standing dead trees (snags) and as fallen trees or other woody material that lies on the ground. A dead tree, from the time it dies until it is fully decomposed, contributes to many ecological processes (Brown et al 2003). These include contributing to the biodiversity of forest life by being part of the life cycle of many animals, vertebrates and invertebrates, providing habitat for feeding, reproduction and shelter. Dead wood plays an important role in protecting the soil, enhancing soil development, and maintaining soil productivity over the long term. Because snags and downed wood are so closely interconnected, they are discussed together in this section.

Affected environment

Snags

Snags are naturally created over time as a result of various disturbance processes that kill trees (fire, insect, disease), and as a natural by-product of succession, as trees die due crowding out by the more dominant trees. Different types of snags have different value to wildlife. They provide important nesting, feeding, perching, and roosting habitat for a wide variety of wildlife species and they are a valuable component of old growth and late successional forest conditions. Refer to wildlife section for details on snag characteristics and value to wildlife species.

Snag densities, sizes and distribution are influenced by the disturbance history (i.e., time and severity of the last fire or insect/disease outbreak) and on pre-existing forest conditions (i.e., size classes or species composition as it might relate to snag longevity). Snag longevity varies greatly both between species, and between individual trees of the same species. Longevity is tied to several factors, including size, species, cause of death, age of tree at death, rate of decay, and site characteristics.

Specific to USFS Region 1, a report providing estimates of snags across western Montana forests was completed by Bollenbacher and others (2009) using the FIA summary database. These estimates and their interpretation for the Flathead is found in the Assessment, with a summary of the key points provided here. See also exhibit xx in the planning record.

Table 19 displays estimates of current snag densities at a broad scale across the Flathead Forest. Additional tables displaying estimates across smaller analysis units composed of groupings of vegetation dominance types and potential vegetation types can be found in the assessment, or in the 2009 report previously mentioned.

Table 18. Current snag densities on the Forest inside and outside wilderness/roadless areas.

	Snags per acre equal to or greater than 10 in. d.b.h.			**Snags per acre equal to or greater than 15 in. d.b.h.**			**Snags per acre equal to or greater than 20 in. d.b.h.**		
Analysis Unit	Mean	Lower bound	Upper bound	Mean	Lower bound	Upper bound	Mean	Lower bound	Upper bound
Outside Wilderness	9.8	7.4	12.5	2.6	1.8	3.4	1.1	0.7	1.6
Inside Wilderness	10.0	7.8	12.4	2.8	2.2	3.5	0.9	0.6	1.1

Evaluation of the data and incorporating an understanding of the ecological processes and vegetation conditions on the Forest contributes to some general statements that can be made about snag conditions on the Flathead.

- Smaller snags are far more abundant than larger snags across all analysis units, and in this ecosystem the very large snags (>=20 inches d.b.h.) are relatively few in numbers. Snags greater than 15 inches d.b.h., and particularly those greater than 20 inches d.b.h., are naturally less common across the landscape, which is related to the forest conditions and growth rates characteristic of the Flathead, and the disturbance and mortality factors that create snags.
- Lodgepole pine dominance types have the lowest density of snags in all the size classes analyzed; forests in the warm moist biophysical setting tend to have the highest density of snags, and greatest number of snags in the largest size classes. This likely reflects the higher productivity of these sites, resulting in larger tree sizes overall.
- Snag densities and other characteristics are very unevenly distributed across the landscape, both historically and currently. Some areas have virtually no snags; others have an abundance of snags. This variability applies at a temporal scale as well. Snag conditions and recruitment is directly dependent on the pattern and frequency of fire, insects and other disturbances (including harvest and other human-caused disturbances), as well as the variation in forest composition and size classes. High snag densities are often the result of wildfires or insect/disease outbreaks which vary widely from decade to decade and from place to place. Low densities of snags could occur under natural disturbance regimes, such as where stand replacement fires occur relatively frequently. Lower densities also tend to occur in areas with greater human access.
- The mean density of snags inside and outside wilderness/roadless show relatively small differences, especially when considering the overlap in confidence interval ranges. This suggests that overall, snag conditions when considered at a forestwide scale, and within the vegetation dominance type/biophysical setting groups, are similar to what might occur under natural disturbance regimes, and are within the natural range of variability.
- At smaller scales of analysis (such as project level), timber harvest and human access can have substantial impacts on snag density, distribution and longevity (Wisdom and Bate, 2008). Presence of localized disturbances (such as fire, areas of insect and disease infestation) could also have substantial influence on snag conditions at smaller, project-level scales, such as a sixth-code watershed.
- FIA inventory data used for the 2009 snag report dates from the early 1990s for the Flathead Forest; thus the contribution to the snag component resulting from several hundred thousand acres of wildfires within the past 20 years are not incorporated into the estimates in Table 19. Estimate of snag densities have increased, which is reflected in Table 20 which uses data from a recently updated FIA database. Snag distribution has also changed, reflecting wildfires that occurred widely across the forest, both within landscapes previously heavily managed for timber production, and within wilderness/roadless areas.

Desired conditions for snags have been developed for the Flathead that are designed to reflect the conditions that would be expected to occur under natural disturbance regimes. Because of the naturally wide variation in snag conditions both spatially and temporally, evaluating and managing for desired snag densities and other conditions (i.e., sizes, distribution) is best considered at a broad scales, such as a watersheds or larger, rather than small scales, such as specific forest stands. Maintenance of a diversity of species requires a landscape perspective and a strategy that considers diversity of habitat structures (Lyon et al, 2000, Tobalske et al, 1991). Larger diameter snags (e.g., greater than 15 inches d.b.h.) are the focus of the desired condition because they are least common and of particularly high value to wildlife (refer to Wildlife section of this EIS). Greater than 20 inches d.b.h. western larch, ponderosa pine and cottonwood of greatest value, followed by Douglas-fir of the same size. These species at these larger sizes tend to have the greatest longevity as snags also. Table 20 displays the current and desired conditions for the larger diameter snag component.

Table 19. Current condition and desired range in average snags per acre of all conifer species as averaged across all forested acres on the Forest, forestwide and by biophysical setting and by snag diameter.

Biophysical setting	Current estimate (>15 in. d.b.h.)	Current estimate (>20 in. d.b.h.)	Desired range in average number of snags per acre greater than or equal to 15 in. d.b.h.	Desired range in average number of snags per acre greater than or equal to 20 in. d.b.h.
Forestwide	4.5	1.6	3.7 – 5.4	1.4 – 2.1
Warm-Dry	2.8	1.1	1.0 – 5.0	0.2 – 2.3
Warm-Moist	4.6	1.8	1.0 – 8.8	0.5 – 4.0
Cool-Moist/Mod. Dry	4.3	1.5	3.4 – 5.4	0.8 – 2.1
Cold	6.0	1.6	3.5 – 8.8	0.6 - 2.8

Source: FIA data using R1 Summary database (Hybrid 2011) analysis tools.

Downed Wood

Snags are not only of ecological value while they are standing, but once they fall they become downed wood that provide important habitat structures for a different and also wide variety of wildlife species, as well as plant species and invertebrates (also refer to wildlife section). Long, larger diameter downed wood is generally more important because it can be used by a greater range of species and provides a stable and persistent structure, as well as better protection from weather extremes. Downed wood is also important for nutrient cycling, moisture retention, as microsites for tree regeneration, and a substrate for a diversity of soil micro-organisms.

Downed wood is derived directly from snags, as well as from live trees or parts of trees that fall due to wind, during fires, and to other factors. Thus the abundance, distribution, sizes and other characteristics of the downed wood component across the Forest and over time is closely tied and similar to that of the snag component described above. Similar to snags, desired conditions for downed wood is to maintain amounts that contribute to forest structural diversity, soil ecological function, and habitat for animal species associated with down wood for feeding, denning, reproduction and shelter. Table 21 displays the current and desired conditions for the amount of downed wood across the forest.

Table 20. Current conditions and desired range in average total tons per acre of downed wood, as averaged across all forested acres within each biophysical setting on the Forest

Biophysical setting	**Current estimate** (total tons per acre)	Desired Range in average total tons per acre of downed woody material
Warm Dry	18.6	10–26
Warm Moist	19.2	8–25
Cool Moist-Moderately Dry	18.6	16–21
Cold	12	9-16

Source: FIA data using R1 Summary database (Hybrid 2011) analysis tools. Upper and lower bounds at a Confidence interval of 90%

Downed wood is highly variable in amount, sizes, species and stages of decay, both across the landscape and over time. The variation could be due to irregular distribution of such disturbances as insect or disease outbreaks and fire events, both of which add dead material to the landscape. Similarly to the snag estimates, recent fires have likely increased the amount of down wood in parts of the forest, and as the snags fall, there will be a period of time where downed woody material will be especially high in these fire areas. Decomposition will reduce this component over time.

Environmental consequences

Effects common to all alternatives

Snag and downed wood conditions are largely dependent on the pattern of natural and human disturbance processes. It is expected that snag and downed wood conditions will be very dynamic, highly variable and unevenly distributed across time and space. Dead wood components will continually be created by fire, insect, disease, and mortality during the course of natural succession. Decomposition and fire are the primary ecological processes that remove – or more accurately, recycle – dead wood within the ecosystem. Vegetation treatments (i.e., timber harvest including firewood cutting, fuels reduction treatments) also remove dead wood. This removed wood may be stored in wood products, but eventually it is also recycled (either through decomposition or fire) though typically not on the site where it originated (refer to Carbon Sequestration section of DEIS for more detailed information). Highest amounts of dead wood would occur in areas where fire or insect/disease outbreaks have occurred, with snags predominant at first, shifting to predominately downed wood as the dead trees fall. Snags will continually be lost as they fall to the ground to then become part of the downed wood component, where they will decompose and become part of the soil. Lower amounts of snags and downed wood would tend to occur in developed sites, areas where concern for fire hazard is elevated (i.e., wildland urban interface), and in areas closer to communities and accessible to firewood cutting. Lower densities and sizes of snags also naturally tend to occur within lodgepole pine dominated stands, unless affected by mountain pine beetle infestation. The majority of Forest lands are within management areas where natural ecological processes and disturbances will be the primary factor affecting snag and downed wood conditions (a minimum of 78 to 87 percent depending on alternative – see Table 13). These natural processes are expected to create an abundance of snags and downed wood at the forestwide scale, and amounts within desired ranges.

Lands where active vegetation management would occur (e.g., lands suitable for timber production) cover a minority of the Forest (from 13 to 22 percent depending on alternative – see Table 13), however they are unevenly distributed across the Forest area. Many of the forests in areas suitable for timber production and within wildland urban interface areas would typically be managed in ways that maintain relatively vigorous trees and limit losses due to insects, disease and fire where possible. This would tend to result in lower tree mortality rates, and a potentially lower density of snags across these areas over time as compared to areas less influenced by human actions and affected more by natural disturbances (such as wilderness). In addition, the majority of the forests in the warm moist biophysical setting are within areas suitable for timber production, as well as a substantial portion of forests in the warm dry biophysical settings. The persistence of snag habitat associated with these biophysical settings will likely be more dependent upon human actions when compared to the cool moist or cold biophysical settings. On the other hand, with active vegetation management there is greater opportunity to manage for species and forest size classes on these lands that would contribute to desirable future snag and downed wood conditions.

All alternatives have standards and guidelines that direct management of snags and downed wood within timber harvest units. These are designed to address the unequal distribution of snags and downed wood across the forest that may be the result of timber management activities, and supports the active role that is more likely to be needed to achieve desired conditions within these actively managed landscapes. This direction has been in place on the Flathead since the late 1990s, with the completion of Amendment 21 for the current forest plan. The revised plan integrates and is consistent with existing plan direction for snags and downed wood, with some change in wording and approach to better achieve desired conditions.

A comparison and discussion of management direction for snags and downed wood between alternatives is provided in Table 22. For more detail on these components and comparison, refer to planning record.

Table 21. Comparison and discussion of different forest plan components by alternative, for snags and downed wood.

	Existing plan[1] alt. A	Revised plan[2] alts. B, C, D	Notes
Snag diameter classes	12 to 20 inches d.b.h. Greater than 20 inches d.b.h.	15 inches d.b.h. and greater 20 inches d.b.h. and greater	To emphasize the selection of the larger diameter snags. If snags greater than 15" are not available, then would drop to 12" d.b.h. for snag selection.
Site (habitat group) categories	Three categories: Dry, Moist and Cold PVG	Four categories: Warm dry, Warm moist, Cool moist-moderately dry, and Cold biophysical settings	To be consistent with other forestwide plan components for key ecosystem characteristics.
Snag retention average/acre minimum	Dry: 3 total Moist: 8 total Cold: 7 total	Warm dry: 3 total Warm moist: 8 total Cool M-Mod Dry: 5 total Cold: 3 total In all settings, require all >20" d.b.h. WL, PP and cottonwood snags be left.	Better reflects our best estimate of conditions related to natural variation. Minimum number of >=20" snags remains the same or increases compared to current plan.
Live replacement trees	Provide 5 live trees >12" d.b.h. for each >20" d.b.h. snag. If cannot meet minimum snag densities, substitute live trees.	Provide live trees in same size class and to same minimum density as snag standard. Focus on selection of live trees with decay, decadent, or otherwise showing values as snag habitat.	Includes additional live tree retention guideline for leaving trees within regeneration harvest units to meet multiple objectives, with a focus on both short and long term desired conditions. This could include retention of trees that would provide important structure components for wildlife habitat (including future snag habitat and old growth development)
Downed wood	Specifies average minimum number of pieces of downed wood to leave within units, in the 9 to 20" diameter and >20" diameter classes, and for Dry, Moist and Cold PVG.	Specifies minimum of 10 tons per acre of >3 inch diameter downed wood left within units, with a maximum of 35 tons per acre. Should consist of longest and largest material available of a variety of decay conditions.	Generally consistent with recommended amounts (Brown et al, 2003) to achieve multiple objectives for typical sites on the Flathead. Amounts would be determined on site-specific basis, with alternative prescription. Tons per acre is used as the indicator and means of measuring and monitoring rather than pieces per acre. This is consistent with the majority of literature and research related to retention of downed wood, and is necessary to allow for effective and efficient monitoring of this component at the different scales, from the stand to the forest level.

Exceptions	Areas >200 feet from open roads, personal use firewood permit areas, tree removal for health and safety, of within developed recreation sites or special use areas. Allows for alternative prescription to meet the snag or downed wood standard.	Areas within 200 feet of open road, issues of human safety (i.e. developed recreation sites), or where minimum number of snags not present. Allows for alternative prescription to meet desired conditions for snags/downed wood.	Provides examples and guidance in Appendix C of the plan for implementing standards and guidelines, and for alternative snag/downed wood prescriptions.

1. Forest-Wide Standards, H. Vegetation (7), pg. II-48.; 2. FW-DC-TE&V-DC 16, 17, 18 (snags and downed wood); FW-STD-TE&V-04 (snags); FW-GDL-TE&V-09, 10, 11 (snags, downed wood, live tree retention)

The Forest has been implementing this plan direction for snag and downed wood at the project level for about 15 years. Monitoring of post-harvest snag and downed wood conditions occurs at a site-specific level. Recent fires, as mentioned earlier, have increased the abundance of snags (and downed wood) across the forest, including areas suitable for timber production. The most recent Forest Plan monitoring report (2010, see planning record), item #70, which addresses snags and coarse woody debris retention, concluded that treatments over the previous decade have been designed to maintain much more structure and provide for protection of current snags to the degree safely possible, including fire salvage prescriptions. The value of dead wood is fully recognized, and there is recognition that treated areas have fewer snags than untreated areas, which was noted as a possible concern over time. However, evaluation of data did not indicate any concerns with meeting desired conditions for snags and coarse woody debris at the broad scale. Direction under all alternatives should continue to meet desired conditions for snags and downed wood, providing habitat and other ecological values consistent with natural disturbance regimes.

Effects common to alternatives B, C and D

Management direction related to snags and downed wood is the same under all action alternatives. As compared to the existing plan (alternative A), the action alternatives provide quantitative and qualitative desired conditions for snags and downed wood, forestwide and by biophysical setting, which, to the best of our ability, is based on our understanding of conditions that might occur under natural disturbance regimes. These desired conditions provides a means to systematically monitor change in these structural components over time and interpret these results in the context of ongoing ecological processes and with conditions of other key ecosystem components.

The presence, abundance and distribution of long-lasting large diameter snags of high value species depends entirely on the presence, abundance and distribution of these species and size classes as live trees across the landscape. Thus, the emphasis under all action alternatives on maintaining or achieving desired forest composition and size classes (particularly of key snag species, such as western larch and ponderosa pine), could be expected to achieve desired conditions for snags (and downed wood) over time as well.

In addition to the presence of larger diameter trees, there is also evidence that the condition of these larger trees prior to death is an important factor in their value and persistence once they become snags. For example, repeated low severity fire and age of the tree appears to play a factor in the long-term persistence of ponderosa pine snags. The injury and resulting pitch flow to the base of the tree, in addition to the advanced ages of the trees and dense wood characteristics appeared to contribute to long-term persistence of these trees once they die and become snags (Smith 1999). Emphasis on use of fire under all the action alternatives to maintain desired stand conditions, particularly in the warm dry biophysical setting, may contribute the desirable snag habitat conditions as well.

There may be slight difference between alternatives related to the difference in amount of area subjected primarily to natural disturbances processes compared to the areas where active vegetation management would occur (lands suitable for timber production). As described earlier, these lands would tend to have lower amounts of snags and downed wood because of access and the integration of other resource desired conditions. Because alternative C has less lands suitable for timber production than alternatives B or D, and more area that would be influenced mainly by fire and other natural processes (see table 12), the amount and distribution of snags would likely differ under this alternative compared to the other alternatives. There could potentially be greater amount of snags and downed wood forestwide under alternative C.

Modeled comparison of alternatives for snags

Wildfire, insects and diseases will provide the main source of snags and downed wood into the future on the Forest. Figure 14 displays the average acres per decade of fire as modeled over a five decade future period. Appendix 2 and exhibit xx also provide information on fire and insect/disease as modeled. Amount of disturbances are similar among all the alternatives, linked closely to climatic conditions. It is apparent that abundant amounts of snags would be available through the natural processes of fire, insect (especially bark beetles) and disease (mainly root disease). Because of its high susceptibility to insect and disease, and its abundance as a species across the forest, Douglas-fir is expected to make up the largest portion of the larger diameter snags (e.g., greater than 15 inches d.b.h.) in the future under all alternatives.

Quantified estimates of future snag densities (of snags greater than 10 inches d.b.h.) and change over time were derived using the Spectrum model (refer to appendix 2). Amounts of snags in the model outputs were driven primarily by fire and insects and disease. There were no limitations or objectives to manage for certain levels of snags in the model. See exhibits in the planning record for more information.

Spectrum modeling showed a consistent trend and similar degree of change in snag densities over the five decade model period among the alternatives. Two size class category of snags were modeled: 10 to 20 in. d.b.h. and greater than 20 in. d.b.h. The proportion of forest area where no or very low amounts of snags in these size classes occur stayed relatively constant over the five decade modeling period. This proportion is about 60% of the area for snags >20 inches that have 0 to 0.9 snags per acre, and 43-49% of the area for snags 10-20 inches that have 0 to 5.9 snags per acre. The area with highest densities of snags increased over the five decade period for both snag size categories. Area with >10 snags per acre 10-20 inches increased an average of about 17% and areas with >4 snags per acre 20 inches or larger increased about 9%. Model results indicate that snag amounts would increase over time, in response mainly to fire and other natural disturbances, and there does not appear there will be a decline or a shortage of this ecosystem component under any alternative.

The models provide no quantitative estimate of downed woody material change over time. However, based on the amount of natural disturbances expected and the changes in snags modeled to occur over time, it is likely that downed woody material will also be available and sufficient to meet desired conditions.

3.3.9 Landscape Pattern

The general pattern of forest structural patches across the landscape is discussed in this section. Forest pattern as related to connectivity of wildlife habitat, including connectivity associated with riparian areas, is discussed in the wildlife section of this EIS. Smaller, but more numerous and discontinuous patches of forest structural types across a landscape, as opposed to fewer but larger, contiguous patches, affects connectivity of wildlife habitat conditions. Different wildlife species are associated with different forest conditions, for example grass/forb/shrub communities, riparian areas, or dense coniferous forest communities. In the wildlife section of this EIS, changes in landscape connectivity associated with mature forest patches is analyzed and discussed (see Wildlife section 3.7.4, Wildlife associated with coniferous forest habitats in a variety of successional stages, Coniferous Forest Connectivity). In the section below, forest connectivity is discussed more broadly and qualitatively, with a quantitative analysis of forest openings (seedling/sapling dominated forests) patch sizes.

Affected environment

The numerous ecological, social and economic values that forests provide are heavily influenced by the spatial patterns that exist on the landscape (Turner et al 2012). The spatial pattern of forest conditions across a landscape can affect ecological processes, including wildlife and plant habitat and dispersal; disturbance risk, spread and size; and human aesthetic values.

Large areas of densely stocked forests and greater landscape homogeneity can create higher potential for large, high severity fire. Research has shown that the spread of wildfires and the potential for large fire growth across a landscape can be limited by reducing fuel continuity (Ager et al. 2010, Collins et al. 2008, Finney and Cohen 2003, Finney 2007, Hessburg et al. 2007, Safford et al. 2009, Stephens et al. 2009). In addition, large landscapes (e.g., wilderness areas) where wildfires have been allowed to burn can develop fuel heterogeneity; therefore, future fires could be limited in size relative to other landscapes that have more homogeneity in fuel conditions (Bollenbacher 2010, Collins et al. 2008, Rollins et al. 2002, and van Wagtendonk 2004). Also, patterns of old burns can delay and detour the spread of new fires.

Large expanses of forest with fairly homogenous conditions of host species of susceptible characteristics and can create higher potential for bark beetle outbreaks (Fettig et al. 2007, Samman and Logan 2000). For bark beetles (as well as other insects or diseases), the severity of outbreaks and tree mortality can be reduced in extent by increasing the diversity of stand ages, size classes, and tree species in landscapes that are homogenous (Bentz et al. 2010, Bollenbacher 2010, Fettig et al. 2007).

In the Flathead assessment, a summary of key findings related to current and historical conditions of forest patterns was provided, which came from a historical range of variability (HRV) analysis conducted on the Forest in the late 1990s by Hessburg and others (refer to the Assessment and to appendix B of the Assessment). That Flathead HRV analysis noted significant departures from historical conditions in patch sizes and density for nearly all forest structural classes forest-wide. This trend mirrored that occurring at the larger Northern Rocky Mountain ecoregion (Hessburg et al. 1999b, 2000a; USDAFS 1996), where drastically increased forest fragmentation was noted. The analysis found a decrease in patch size and corresponding increase in patch density for most of the forest structure classes (generally equating to forest size classes), resulting in a trend of increasing forest fragmentation. This change was most dramatic for the early successional forest patches (e.g., seedling/sapling forest size class) and the pattern for the early successional forests was found to be outside the range of historical variability. Also of concern was the pattern for forests in a closed canopy, single storied stand structure (generally equates to small and medium forest size classes as used in this EIS), which were found to have more and much larger sized patches across the Flathead. This appeared to be attributable to the transition of historical large early successional forest patches created by fire to the densely stocked mid successional forest structures.

For this EIS, an updated analysis of historical, or natural, range of variation (NRV) in early successional forest patches was conducted, because large areas of the forest have experienced fire since completion of the Flathead HRV analysis. Although these fires undoubtedly altered the average patch sizes and distribution of all forest structural classes (i.e. size classes) it is the size and distribution of patches in the early successional seedling/sapling forest size class that will form the basis of the analysis and description of forest pattern and connectivity in this EIS. As described earlier in the section on vegetative succession, the dominance of grass, forbs, shrubs and short trees within these early successional forests creates a patch – an opening – that forms strong contrast (e.g., forest "edge") and is distinctly different from the adjacent mid or later successional forest conditions. Not only does this allow for more accurate detection and measurement of the patch and resulting landscape patterns (both for analysis of current and historical conditions), the early successional forest patch type is particularly meaningful for evaluation of wildlife habitat conditions, forest cover and connectivity. The larger trees and denser forest cover present in the mid and late successional forests provide the connectivity of habitat important to many wildlife species (refer to wildlife section for greater detail on forest connectivity for wildlife species). Early successional stages also represent the crucial initiation point of forest development, and forest conditions and landscape patterns created at this early stage greatly influence the conditions and landscape patterns of forest compositions and structure of the future.

Table 23 displays results of this NRV analysis and Table 24 the current condition. Refer also to planning record exhibits.

Table 22. Natural range of variability in early successional forest patch size (acres) created by stand replacement fire, forest-wide and by biophysical setting; all land ownerships within the administrative boundaries of the Forest.

	Arithmetic Average patch size (acres)			Area Weighted Mean[a] patch size (acres)		
Biophysical Setting	**Global average**	**Min**	**Max**	**Global average**	**Min**	**Max**
Forestwide	288	171	442	37,668	14,523	68,933
Warm Dry	102	84	134	15,972	6,131	41,685
Warm Moist	103	74	128	4,126	1,791	7,042
Cool moist-Mod dry	188	133	247	16,924	7,812	27,117
Cold	83	70	102	963	646	1,498

Source: SIMPPLLE model, wildfire events as simulated over past 103 decades, average of 30 repetitions.

[a] Area weighted mean - Each patch gets a weight based on the size of the patch, and the bigger patches get more weight.

The NRV analysis for early successional patch sizes indicates that there was rarely if ever a decade historically when there weren't some openings/early successional forest created by fire somewhere across the forest and within each biophysical setting. The great majority of fires were relatively small (as indicated by the arithmetic average). However, when the big fires did occur, they were very large indeed (as indicated by the area weighted mean). These large fires, or series of fires within a one or two decade period, would typically be associated with extended warm climatic periods, and drought conditions.

To determine the current patch size of early successional forest openings, forests that have been burned with wildland fire or harvested over the past 25 years were included in the analysis. Total acres, mean patch size, range in patch sizes and number of patches currently existing across Forest lands were determined using up-to-date fire and harvest maps (as of 2013). Results are displayed in table 24.

Table 23. Current condition of early successional forest patch size (acres), forest-wide and by biophysical setting; Forest lands.

Bio Setting	Arithmetic average size of patch	Min. size of patch (acs)	Max. size of patch (acs)	Count of patches	Sum of acres in early successional forest patches
Forest-wide	108	5	41,781	4028	437,390
Warm Dry	57	5	5480	969	55,223
Warm Moist	28	5	363	364	10,158
Cool Moist Mod Dry	185	5	41,782	1734	320,844
Cold	72	5	3000	611	43,844

Source: FACTS data base and spatial GIS layers in FNF GIS library.

The recent fires (i.e. within the past 25 years), burning about 17% of Forest lands, have created the majority of current early successional forest acres. Timber harvest comprises a much smaller portion of the total acres of the current early successional forest patches, with an estimated 72,000 acres, or 3% of Forest lands, harvested with regeneration cuts during the past 25 years. Comparing the current average in Table 24 to historical global average it appears that current patch sizes forestwide and as distributed across the forest in the biophysical settings is not dramatically different from an expected historical condition. In addition, maximum size of patch appears consistent to historical conditions at the forestwide scale, though the acres vary substantially when considered at the biophysical setting scale. Very large patch sizes appear to occur historically in the warm dry setting, whereas the largest patch sizes currently are within the cool moist-mod dry setting. This is likely due to the fact that the historical analysis considered lands in all ownerships, and warm dry biophysical setting occupied a much larger area historically, including most of the main Flathead Valley and lower elevation foothill lands surrounding the valley. These areas are nearly all in non-NFS ownership currently and not included in the calculations within Table 24.

In summary, in the ecosystems of the Forest, fire was, and continues to be, the primary process that creates early successional forest patches and their size and distribution within the larger matrix of mid and late successional forests. Fires occurred historically with regularity, with hardly if ever a decade passing without a fire occurring somewhere in the landscape. During wetter climate cycles, these fires might be relatively small, scattered, or less severe; during drier climate cycles large fires thousands of acres in size could occur. The pattern of forest openings intermixed with areas of denser mid and late successional forest would thus also be ever changing over time and space, influenced by disturbances and the continuous process of succession.

Environmental consequences

Desired conditions for the pattern of forest structures across the landscape is for patterns to be consistent with spatial and temporal arrangement that would occur under natural disturbance regimes. Describing and measuring forest patterns can be convoluted and complex. As described under the affected environment section, the size and distribution of patches in the early successional seedling/sapling forest size class form distinct openings within the denser forest matrix and are used to evaluate pattern and connectivity at the forestwide scale. As would occur under the natural fire regimes, it is desired that early successional patches vary widely in size, shape and conditions (such as tree density and number of canopy layers). The majority of seedling/sapling patches are less than 300 acres in size, but very large patches (e.g., those greater than 30,000 acres) are expected to occur, though less commonly (i.e. they may exist for one 20 year period over an 100 year time span). Largest patch sizes are desired occur predominantly within wilderness and large unroaded areas, and smaller patch sizes (e.g. less than 300 acres) occur mostly outside these areas. In addition, there are desired patch and pattern characteristics unique to each biophysical setting, as described in the revised forest plan (FW-DC-TE&V-19).

Effects common to all alternatives

The existing plan and the draft plan include plan components that address the desire to manage for landscape patterns similar to that expected under natural disturbance and succession regimes. Under all alternatives, the majority of the Forest is primarily influenced by natural disturbance processes, rather than timber harvest activities (see Table 12). Moderate and high severity fire (both wildfire and prescribed fire) is a major disturbance process that would expected to occur within these areas, creating future early successional forest patches as well as a diversity of other forest structural condition (densities, size classes). The amount of fire that potentially could occur in future years (refer to Figure 14), and the resulting amounts of seedling/sapling size class, as well as lower density forests (e.g., moderate fire severity) that would be created over time would have the potential to create a pattern and patch size across most of the landscape that would be similar to natural disturbance and succession regimes. In areas where fire is aggressively suppressed, early successional patches will likely be smaller in size on average. However, even in these areas larger patches of early successional forest will also likely occur, as recent experience has indicated that not all fire is likely to be eliminated under even the most aggressive suppression strategies.

Warming climates may alter this scenario in the future. It would be expected that extended periods of warm (and associated dry) conditions may increase both fire size and severity (Loehman et al., NRAP in press), and this may create patterns that would deviate from historical conditions.

Effects common to alternatives B, C and D

The action alternatives place greater emphasis on managing for resilient landscape patterns and for the connectivity of forest conditions that provide for needs of wildlife species. Specific forest plan components are provided, that describe desired conditions for forest patterns forestwide and by biophysical settings (FW-DC-TE&V-03 and 09). This recognizes the importance of forest patterns in contributing to overall ecosystem and landscape resilience. In addition, the revised plan includes components that provide direction for maximum size of regeneration harvest units that is more consistent with the early successional forest patches under natural disturbance regimes (FW-STD-TIMB-07). Because of this increased focus on pattern and connectivity, desired conditions are more likely to be achieved under the action alternatives, both on lands where fire and other natural disturbances will be primary, and on lands suitable for timber production, where harvest will be a more dominant disturbance.

Modeled comparison of alternatives

Patch analysis and modeling of changes in wildlife corridor areas was conducted for wildlife species associated with coniferous forests. Refer to the Wildlife section of this EIS, and to the discussion for marten specifically.

3.3.10 Summary of modeling results and environmental consequences related to forest resilience

Under the sections on vegetation composition, forest size class and forest densities, a discussion and comparison of alternatives of the modeled changes was provided relative to the desired conditions. This section provides additional information on the modeling results, and integrates results to provide an evaluation of alternatives relative to maintaining or restoring resilient forest conditions on the Flathead. Appendix 2 and exhibit xx in the planning record provide more detailed information of the modeling and the model results, including a table summarizing the quantitative results from the SIMPPLLE model.

Modeled components key to resilience on the Flathead

Listed below are primary components that would contribute to the overall strategy to maintain or achieve resilient forest conditions on the Flathead, and for which vegetation modeling methods were employed to aid the evaluation of alternatives. In combination, these resilience components help achieve the broad goal of increased species and forest structural diversity at both the stand and landscape scale. Detailed discussion of how these conponents contribute to forest resilience is found in their respective sections earlier in this chapter (i.e., sections on vegetation composition, forest size class and forest density), and not repeated in depth in this section.

Vegetation composition

a. Increase presence and dominance of ponderosa pine
b. Increase presence and dominance of western larch
c. Increase presence and dominance of whitebark pine
d. Increase presence of western white pine
e. Limit dominance of Douglas-fir, particularly in warm dry biophysical setting
f. Limit dominance of subalpine fir in overstory canopy layers and in cold biophysical setting (whitebark pine habitat)
g. Maintain uncommon species or vegetation types, specifically hardwood and persistent grass/forb/shrub communities

Forest size class

h. Decrease proportion of small size classes
i. Increase proportion of large size class
j. Increase proportion of very large size class and presence of very large trees (>20 in. d.b.h.), particularly fire/insect/disease resistant species

Forest density

k. Reduce high density forest conditions where appropriate, focus in wildland urban interface, and warm dry and cold biophysical settings

Environmental consequences

Individual model results and alternative comparison

As described earlier in this chapter (introduction section 3.3.1), simulation of vegetation change for five decades into the future was conducted using the SIMPPLLE model, with vegetation changing in response to vegetation treatments (timber harvest and prescribed burning), natural disturbances (fire, insect, disease), vegetation succession and climate (see appendix 2). Thirty simulations were run to capture the variation that would be expected in disturbance processes over time, and the variation in vegetation conditions that would result. Therefore, model results provide not a single value but a range of values for vegetation condition by the end of the modeling period (decade five). Key model results for each component of the resilience strategy and comparisons between alternatives are summarized below.

a. <u>Ponderosa pine</u>: Though desired conditions were not achieved over the model period, all alternatives indicated a strong upward trend in species abundance (dominance type) and distribution (species presence) on the warm dry setting, and forestwide. The increase on the warm dry setting is particularly desirable, because this is the setting where this species presence is most suited. Though ponderosa pine did not achieve the minimum desired level in the warm dry setting over the model period, it is trending in that direction. Alternative D showed the greatest increase (estimated 6%), followed in order by alternative A, B and lastly alternative C (estimated 3% increase). These increases are linked mostly to the amount of timber harvest and low/moderate severity fire (prescribed fire and wildfire), both of which would favor ponderosa pine establishment and persistence.

b. Western larch: An indication of a small but discernable upward trend in distribution (species presence) on the warm moist and cool moist-moderately dry settings occurred equally under all alternatives, maintaining or moving this species towards desired conditions. Forestwide, there may be a small increase forestwide in species dominance type as well. There was no change in species distribution (species presence) forestwide. The species meets desired conditions in the warm dry, warm moist and (barely) in the cool moist-moderately dry settings. The increases in this species were not as strong as desired in the cool moist-moderately dry setting in particular, but it appears to be at the least maintaining itself across the landscape and at best may be on a slow upward trend, at least on some portions of the forest. Western larch declined on the warm dry setting in all alternatives, though it appears that it is being replaced by desired species (ponderosa pine). With warming climate conditions, the warm dry setting is likely to become less suitable for western larch. Additional loss of larch may be due to vegetative succession in the cool moist-moderately dry setting.

c. Whitebark pine: All alternatives show a desirable increase in this species presence in the cold biophysical setting, with the greatest increase indicated in alternatives A and D, and the least in alternatives B and C. Though desired conditions are not achieved in the cold setting, it appears the species is trending in the right direction. In reality, the complexities associated with restoration of this species (see section 3.5.1) is difficult to reflect through vegetation modeling. It is likely that there will be relatively little measurable change in whitebark pine abundance or distribution over a fifty year time period. Restoration efforts, with particular focus on planting or seeding, are centered on sustaining and increasing this species over the long term.

d. Western white pine: Though desired conditions were not achieved over the model period, all alternatives indicated an upward trend in species distribution (species presence) on the warm moist biophysical setting under all alternatives, with the greatest increase in alternative B (about 8%), followed by alternative D and A, and the least increase in alternative C (about 2%). The increase in this western white pine on the warm moist setting is particularly desired, because these are the sites where the species is best suited. The increase in this species is linked closely to the amount of timber harvest (regeneration harvest) which favors its establishment (planting) and growth. Planting of western white pine after wildfire would also occur in all alternatives, increasing the distribution of this species, though model design does not account for this activity.

e. Douglas-fir: A strong downward trend in species distribution is evident under all alternatives in the warm dry biophysical setting, and all achieve desired conditions for this species in this setting. This is a particularly desirable outcome, as this is the setting where this species is currently above desired maximum amounts and most likely to be contributing to forest structures (i.e., densities) and species compositions that are less resilient. The decrease in Douglas-fir on the warm dry setting is probably tied directly to the increase in ponderosa pine, which is linked to both harvest and prescribed fire treatments. Alternative D shows the greatest modeled decrease in Douglas-fir (about 25%), followed by alternatives B and C, with the least decrease noted under alternative A (about 15%).

   Douglas-fir distribution nearly exceeds desired amounts within the warm moist biophysical setting, and under alternatives B and D a downward trend occurs by decade five of the model period. This will increase resilience of the forests within this setting, by decreasing forest hazard for Douglas-fir beetle and root disease. Douglas-fir distribution increases by the fifth decade in alternative C, which puts it above desired conditions. Under alternative A, there is also an undesirable upward trend, though it remains within (barely) desired conditions at the fifth decade.

f. Subalpine fir: All alternatives show a strong decrease in distribution of this species (species presence) in the cold biophysical setting, which is particularly desirable because these are the areas where whitebark pine is most likely to replace the subalpine fir. Alternative B shows the greatest modeled decrease of about 18%, followed by alternative D. Least decrease occurs in alternative A and C, estimated at 8%. In all alternatives, subalpine fir dominance type remains at high level across the forest, nearly above the desired upper range. This could potentially reduce overall forest resilience, especially if the increase in subalpine fir is occurring at the expense of western larch or western white pine. Forests dominated by subalpine fir and other true firs (i.e., grand fir) are typically more susceptible to damage from western spruce budworm, root/stem/butt rot fungi, and other damaging agents. Multi canopy and dense forest conditions are common in subalpine fir dominated forests, potentially increasing fire severity.

g. Hardwood and Grass/Forb/Shrub Types: Hardwoods appear to at the least maintain their presence as a vegetation type across the forest, and at best show a small increase of about 1% forestwide by the fifth decade under all alternatives. Grass/forb/shrub communities have increased by the fifth decade in the action alternatives, but decreased in alternative A. This plant community varies over the model period, corresponding closely to the amount of fire (high and moderate severity wildfire and prescribed fire). Both of these non-forest vegetation types meet desired conditions. On the Flathead Forest, the hardwood dominance type tends to occur as small patches and stringers scattered amongst the large matrix of coniferous forest types. It also occurs as a transitory vegetation type in the early successional stages of coniferous forest development. Due to its very fragmented and sometimes transitory nature, it is difficult to not only map its current location and distribution, but to model its change over time. Like grass/forb/shrub communities, its presence and abundance is closely tied to disturbances (fire and harvest), though it is limited to certain site conditions (i.e., moist riparian areas, toes of slopes). It is likely future trends in presence and distribution of hardwoods (particularly aspen and birch types) will be similar to trends in the disturbance processes.

h. Small forest size class: A downward trend occurs for the amount of area in this size class under all alternatives, forestwide and within all biophysical settings. This is generally a desirable trend in that this size class declines from either the very high end or above desired conditions, to well within desired conditions forestwide and in all but the warm dry biophysical setting. This helps to bring size classes into a more desired balance, and suggests that the diversity and potentially the pattern of forest successional stages across the landscape has been improved over time. In the warm dry setting, the proportion of small size class appears to decline to below minimum desired levels in all the action alternatives, but stays around the same for alternative A. Much of the change in size classes is associated with forest growth and successional progression (seedling/sapling growing into small size class and small size class growing into medium size class).

i. Large forest size class: All alternatives indicate there will be strong increase in the amount of area in the large size class by the fifth decade forestwide, and in the warm moist, cool moist-moderately dry and cold biophysical settings. This is a very desirable trend, and all alternatives meet desired conditions for the warm moist and cold settings, though not quite up to minimum desired levels forestwide or in the cool moist-moderately dry setting. Along with the decrease in small size class, this change brings forest size classes into more acceptable balance, and suggests that the size class/successional stage diversity and pattern has been improved over the model period. Vegetative succession is responsible for majority of changes in the size classes, as trees grow and advance into larger forest size classes. The warm dry setting shows a decline in the large forest size class in all alternatives, which is not a desirable trend in itself, and alternative D declines to below desired levels. However, this trend is likely associated with the increase in the very large size class within this setting, as discussed in the next paragraph.

j. Very large forest size class: All alternatives indicate that there will be an increase in the amount of area in this size class by the fifth decade in the warm dry and warm moist settings, and all alternatives meet desired conditions in the warm dry setting, moving well up into the desired range. This is an especially desirable result forestwide, but particularly in the warm dry, where the most notable increase occurs and many of these larger trees are ponderosa pine. Alternative C shows the largest modeled increase of about 7%, followed by alternative B (about 5%). Alternatives D and A model an increase of about 3 and 2% respectively. As with the small and large size classes, vegetation succession is largely responsible for these changes in forest size classes. However, low intensity prescribed fire and commercial thinning also is influencing these changes by removal of smaller trees in favor of larger. In the warm moist the increase in very large size class is smaller, an estimated 1% for alternatives A, B and D, and 4% for alternative C. Many if not most of the very large trees in the warm moist setting are probably western larch and Douglas-fir. Fire is expected to play a larger role in the future as a management tool to create desired vegetation conditions, as well as potential increases in wildfire. Increase in tree sizes, particularly of fire resistant species, is important to improving forest and ecosystem resilience.

Downward trends in the very large forest size class are modeled forestwide and in the cool moist-moderately dry and cold biophysical settings. Forestwide, there is about a 2 to 3% decline, with a decrease of about 4 to 5% estimated in the cool moist-moderately dry. This decrease in very large trees highlights the effect of increasing levels of natural disturbances, in response largely to warmer climate conditions as modeled in decades 3-5 of the model period. Though harvest may play as small part, Douglas-fir and spruce bark beetle, as well as fire, affect far more area on the Forest and likely account for much of the loss of very large forest size class. This decline is an does not meet desired conditions for maintaining or trending upwards in this size class. The loss of large diameter trees, particularly fire resistant species, may reduce overall forest resilience and forest structural diversity. It emphasizes the importance of promoting growth and development of fire, insect and disease resistant species today, to provide for the desired live, large trees in the future.

k. Forest density: All alternatives show a desirable downward trend in the high canopy cover class forestwide and within all biophysical settings. In the warm moist and cool moist-moderately dry settings, the high canopy cover class shifts to both low and moderate canopy cover classes. In the warm dry setting, the shift is towards the low the very low canopy cover classes. These would be expected shifts on these settings, and achieve a desirable distribution and diversity of forest densities. The changes suggest that resilience in forests is being increased by reducing competition and associated stress between trees. Resulting effects should include improved tree vigor and growth; reduced forest fuels and potential severity of fires when they do occur; decreased impacts due to insects and disease, particularly bark beetles and western spruce budworm.

Integrated results and alternative comparison

As is apparent from the discussions above, there are many similarities between the alternatives in the trends that occurs over the five decade model period for the resilience components. There is variation between alternatives as to the rate of change and which do better at achieving desired conditions over the model period among the eleven different resilience components. This section integrates the model results for the components to provide a comparison of alternatives regarding how well they meet desired conditions for resilient forests. Refer to exhibit xx for more detailed model results and comparisons.

Model results suggest that alternative B is the best overall at achieving desired conditions and trends related to forest resilience, followed in order by alternative D, A and C. However, the difference between alternatives in model results over the five decade period is often small in magnitude. Both alternatives B and D do best at meeting desired conditions and rate of change related to overall forest composition and promoting desired trends in species. All alternatives show the same trend for components related to forest size classes, but alternative C does the best at achieving desired increases in large and very large forest size classes. All alternatives do equally well at achieving desired trends in both hardwood vegetation types (where they all show a slight increase over the model period), and forest densities (where they all show a decrease in high canopy cover class over the model period).

All alternatives have similar amounts of modeled natural disturbances, such as fire and insect or disease activity, which would influence vegetation conditions over time similarly between alternatives (refer to discussions under earlier sections of this chapter). The differences among alternatives suggest that active vegetation management, with an objective to achieve desired conditions for the resilience components, is of some importance to improving the rate of desired changes in vegetation over time, particularly associated with tree species diversity and promotion of early successional species. Timber harvest treatments (with associated reforestation) and prescribed fire, can be designed and strategically located to treat forest types and sites in ways that promote desired species compositions. Areas where active vegetation management, particularly timber harvest, can occur comprises less than 25 percent of the Forest area, so the ability to influence vegetation with these activities is limited (see section 3.3.2).

3.3.11 Consequences to vegetation and terrestrial ecosystems from forest plan components associated with other resource programs or revision topics

Effects from access and infrastructure

In all alternatives, limits related to road access on existing roads as well as construction of new roads (both permanent and temporary) could have a substantial impact on the ability to conduct vegetation treatments, particularly mechanical treatments, across portions of the forest, due to lack of economically feasible access on lands suitable for timber production. Alternative A requires that an estimated 518 miles would need to be reclaimed, and either on the transportation system as impassable or off the transportation system as decommissioned; Alternatives B and D would maintain existing road density and management; Alternative C would reduce the amount of existing wheeled motorized use by an estimated 75 miles. These limits are largely associated with grizzly bear conservation direction, recommended wilderness designations, and wildlife security. In addition, all alternatives would apply access and road use limitations within areas identified as grizzly bear secure core. Limited access to conduct desired vegetation treatments would affect the ability to achieve desired vegetation conditions. Alternative A access would limit vegetation treatment the most, followed by alternative C. Though restrictions on access and road management occur within Alternatives B and D, they would be the least limiting of the four alternatives.

Certain vegetation treatments in areas of higher scenic values may also be limited, due to incompatibility with forest plan components related to scenic integrity. Effect to scenery is typically localized and would be determined in project-level analysis.

Effects from wildlife management

Effects of grizzly bear standards that limit road access was discussed in the previous paragraph under roads and infrastructure.

Under all alternatives, forest plan standards associated with the Northern Rockies Lynx Management Direction (NRLMD) restrict vegetation treatment activities within Canada lynx habitat, which occurs across the vast majority (over 75 percent) of the Forest (refer to Wildlife Threatened and Endangered Species section 3.7.5). There are two standards in particular that are most limiting, listed below. Only a very brief and paraphrased summation of the content of these standards is listed; refer to appendix F for full details related to this and other direction for management in lynx habitat.

NRLMD Standard VEG S5. Does not allow pre-commercial thinning projects that reduce snowshoe hare habitat in seedling/sapling size stands (outside the wildland urban interface)(figure B-15) except in very limited situations.

NRLMD Standard VEG S6. Does not allow vegetation management to reduce winter snowshoe hare habitat in “mature multi-story forests” (outside the wildland urban interface)(figure B-15) except in very limited situations.

VEG S5 reduces the ability and effectiveness of achieving desired vegetation conditions across portions of the forest, by restricting the use of pre-commercial thinning, which is one of the most effective tools available to trend forests towards desired composition, densities, size classes (e.g., large and very large trees), and improved resilience over time. Large portions of the forest have been recently impacted by stand replacement fire, and fire is expected to be a common disturbance in the future. Of greatest concern related to restrictions on pre-commercial thinning is the potential impacts on western larch and its contribution to forest resilience and desired wildlife habitat conditions (refer to Vegetation section for more details on the role of western larch). Western larch grows very poorly in high density conditions, and can be outcompeted in the early stages of succession by other species more able to cope with high densities, such as lodgepole pine.

Effects related to VEG S5 restrictions would be most evident in the areas suitable for timber production (see Table 13), because of accessibility, and outside wildland urban interface (figure B-15). The proportion of the suitable lands currently in a seedling/sapling size class, within lynx habitat and outside wildland urban interface is estimated to be nearly 97,000 acres (alternative B and D), and slightly less in alternative C. Not all of these young stands are in a condition that is feasible or beneficial to thin at this time, nor would current or anticipated budget levels support thinning all these acres. Assuming current budget levels, there would be opportunity to pre-commercially thin up to 2700 acres per year over the life of the plan (15 years) in lynx habitat outside the wildland urban interface (see planning record exhibit V-42) under all alternatives. These are thinning acres that would not qualify for thinning under the VEG S5 exceptions #1, 2, 4, 5 or 6, but have the potential to qualify under VEG S5 exception #3, which allows some thinning to occur based on new information that has gone through an approval process (see Appendix F). This documentation and approval process has not yet occurred.

Restrictions on harvest in multi-story forests (VEG S6) also would potentially reduce ability and effectiveness of achieving desired vegetation conditions across portions of the forest. Multi-story forests that provide winter snowshoe hare habitat commonly develop on the Flathead through the forest successional process on the cool moist-moderately dry, cold and warm moist biophysical settings. In practice, adhering to VEG S6 has resulted in harvest treatments rarely being feasible in multi-story habitat, due to the damage to understory trees that would typical occur with any ground based harvest system, even in a partial cut, such as a thinning. In addition, though VEG S6 does not apply to wildfires, it does apply to planned ignitions, e.g., prescribed fire. In lieu of wildfire use, prescribed fire is the only management tool to use across the majority of the Flathead Forest (refer to Table 12). Typically, the objective of prescribed fires is to reduce stand densities by removal of the understory, and in some forest types (such as subalpine fir and lodgepole dominated forests), removal of portions of the overstory to create patches of more open forest conditions across the landscape. Prescribed fire with these objectives would not be able to occur in multistory hare habitat.

As with VEG S5, VEG S6 direction would potentially have undesirable impacts to forest resilience in portions of the forest. Advancing succession in the cool moist forest types would result in an increased abundance and density of subalpine fir, spruce and to a lesser extent Douglas-fir. Multi-story hare habitat is likely to have forest structures and densities that tend to be of higher susceptible to high severity fire as well as to damage and mortality of the true firs and spruce from western spruce budworm, bark beetles, and other agents. Warming climate will increase the potential for high severity fires. As with VEG S5, the desire to increase early successional species, and specifically western larch and western white pine, may be most affected by the inability to create open conditions across portions of the landscape, either through prescribed fire or harvest. Wildfire use is often not a feasible option. However, wildfires will continue to occur, and will likely burn mostly at high severity in these vegetation types, increasing the probability of loss of seed sources for western larch.

VEG S6 standard would potentially reduce the ability to achieve desired conditions for vegetation within management areas designated suitable for timber production, outside the wildland urban interface (figure B-14), and within lynx habitat. In alternatives A, B and D, these lands comprise approximately 320,000 acres, nearly half of the total acres within management areas suitable for timber production, and about 87% of the total acres suitable for timber production outside the wildland urban interface. Alternative C would have less acres suitable, but would have similar relative percentages as alternatives A, B and D.

Sites that support whitebark pine also occurs in lynx habitat and would be subject to the same restrictions on vegetation treatments discussed above. Because it is recognized as a species of concern, lynx standards provide for somewhat greater flexibility for restoration treatments in whitebark pine, and restrictions on vegetation treatments due to lynx direction would have minimal impact on whitebark pine restoration. Refer to appendix F and to the effects on whitebark pine in section 3.5 of this EIS for detailed discussion.

Western white pine is another species in lynx habitat that is affected by management restrictions in lynx habitat. It too is a focus species for restoration efforts and there is some flexibility provided in the current lynx habitat management direction for restoration treatments, particularly with thinning in young sapling stands, which would benefit restoration efforts for western white pine. However, open forest conditions are required for the most successful regeneration and perpetuation of this species, particularly by planting of rust-resistant seedlings. VEG S6 restrictions would affect the ability to conduct regeneration restoration treatments for western white pine within lynx habitat and outside the wildland urban interface. The most suitable sites for western white pine occur on the warm moist biophysical setting, which is mostly (70%) within the wildland urban interface and would have greater flexibility for harvest and associated planting under VEG S6. This would be beneficial in regards to achieving desired conditions for western white pine under all alternatives. However, approximately 30% (60,000 acres) of lands outside the wildland urban interface are suitable habitat for western white pine. Standard VEG S6 would restrict the ability to apply restoration treatments for this species, specifically by limiting the creation of openings within multi-story hare habitat where successfully establishment and growth of western white pine could occur.

Effects from fire management

Fire management using prescribed burning and the use of natural, unplanned ignitions to meet resource objectives generally has a positive effect on vegetation condition. Management direction in the revised Forest Plan under all action alternatives emphasizes and provides greater flexibility in the use of both prescribed and natural, unplanned ignitions to improve vegetative conditions. As discussed earlier in this section, fire is an important tool in moving vegetation towards desired condition, especially where desired species can be established in the burned area, either through natural regeneration from on-site seed sources or through planting. Compared to Alternative A, all of the Action Alternatives would utilize fire (both prescribed and natural, unplanned ignitions) to a greater degree and that tool would improve the overall condition of the forest vegetation.

In lands within the wildland urban interface and near communities, a continued policy of heavy fire suppression will require that mechanical treatment methods be used in order to reduce hazardous fuels and trend the vegetation towards desired conditions. This effect is common to all alternatives.

Effects from watershed, soil, riparian, and aquatic habitat management

All alternatives contain direction that protects watershed integrity, soil productivity, riparian values and aquatic habitat management. This direction limits and guides the type, amount and location of vegetation treatment activities that have the potential to impact these resources, as well as the roads needed to access treatment areas. Forest plan direction in alternatives B, C and D recognizes that vegetation treatments within RMZs may be beneficial and needed to achieve desired conditions and provides direction to increase efficiency and flexibility for managing in certain areas within RMZ, as determined through site-specific analysis. Though vegetation treatments in RMZs are not prohibited in the existing forest plan, alternative A does not provide as clear direction and flexibility as the action alternatives, and thus could be more limiting on the ability to trend forest towards desired conditions.

Effects from recommended wilderness area designations

All action alternatives would have the same level of ability to achieve desired vegetation conditions within recommended wilderness areas through the use of vegetation treatments. All have forest plan direction that allow "restoration work activities where the outcomes will protect the wilderness characteristics of the areas as long as the ecological and social characteristics that provide the basis for each area's suitability for wilderness recommendation are maintained and protected" (Draft Revised Forest Plan, MA1b-SUIT-06). Anticipated vegetation treatment activities would largely be associated with the restoration of high elevation ecosystems, and whitebark pine forest communities in particular. Refer to section 3.5.1 under whitebark pine for detailed documentation of effects related to the whitebark pine restoration objectives and recommended wilderness designation. In addition to restoration activities associated with whitebark pine communities, in some of the recommended wilderness areas there may be other treatments occurring to achieve restoration objectives outlined in the plan components. The most likely treatment would be prescribed burning (planned ignition), in some cases followed by limited planting of conifer seedlings. Objectives would include restoration of desired forest structure and compositions (for example, to promote western larch), and to restore desired landscape patterns.

Future wilderness designation of recommended wilderness areas could be anticipated. Designation as wilderness would likely result in reduced flexibility and options for vegetation management to achieve desired conditions. Use of prescribed fire is typically not allowed within designated wilderness areas, and the ability to use unplanned ignitions (wildfire) as a tool would be very limited within some of the recommended wilderness areas. This is because of the small size and/or in locations of the areas and most wildfires would likely have to be aggressively suppressed to protect identified values (i.e., private lands). Loss of ability to use prescribed fire treatments would limit ability to achieve desired vegetation conditions across portions of the landscape, for example to create openings where desired species, such as western larch or western white pine, would have opportunity to establish. Refer also to discussion in section 3.5.1 of this EIS, specifically for whitebark pine, for additional detailed information on these potential effects.

Effects from air quality management

The consequences to forest vegetation from air quality related Forest Plan direction are the same for all alternatives. All alternatives have direction to meet air quality standards established by federal and state agencies and meet the requirements of state implementation plans and smoke management plans. The direction limits the use of prescribed fire to manage forest vegetation by limiting how much can be burned and when and where it can occur. The costs of conducting prescribed fires increases as a result of the burning regulations, which affect how much is burned. Limited use of prescribed fire affects the ability to move vegetation towards desired condition under all alternatives.

Effects from mineral extraction

Mining undergoes site-specific NEPA analysis to determine effects and required mitigation, and effects to vegetation from mining is determined at the project level. Generally, the impacts to terrestrial vegetation from mineral extraction on the forest are very localized, and at the forest-wide scale they would be insignificant.

3.3.12 Cumulative Effects

The effects that past activities have had on all of the components of forest vegetation (e.g., forest composition and structure, landscape pattern, etc.) were discussed in the "Affected Environment" section and are reflected in the current condition of the forest vegetation. Therefore, unless otherwise noted, past activities are not carried forward into the following cumulative effects analysis. In addition, the section above that discusses consequences to vegetation from forest plan components associated with other resource programs or topic is a form of cumulative effects analysis.

Present and foreseeable future activities that could affect forest vegetation are summarized below:

Climate change

Climate is integrated into the SIMPPLLE model and a major driver of vegetation change and effects of the alternatives over time, as discussed in the earlier sections on vegetation composition and structure. Potential effects of climate change are described in both the introduction to Chapter 3 of this EIS, and briefly in the introductory sections of this vegetation section. As mentioned, there is a great deal of uncertainty surrounding climate change and its potential effect on vegetation conditions. However, best available science was used to guide both the integration of future climate conditions into the SIMPPLLE model, and the evaluation of the vegetation change related to direct and indirect effects of climate change. Whether it is invasive species (e.g., white pine blister rust), drought, uncharacteristic wildfires, elevated native insects and disease levels, unusually high forest densities, or some other agent or combination of agents that serves to stress trees and forest ecosystems; recent research suggests that climate change will likely exacerbate those stressors and "stress complexes" will continue to manifest themselves (Keane et al, NRAP 2015).

Increasing human population

Additional stressors that may increase in the future are increasing population levels, both locally and nationally, with resulting increasing demands and pressures on public lands. As related to forest and vegetation conditions, these changes may lead to increased demands for commercial and non-commercial forest products, elevated importance of public lands in providing for habitat needs of wildlife species, and changing societal desires related to the mix of uses public lands should provide.

Increased regulation and concern over smoke emissions

The ability to implement the vegetation treatments that would occur as a result of the alternatives is highly dependent upon prescribed burning (both associated with timber harvesting and without it) as well as using natural, unplanned ignitions to meet resource objectives. Therefore, to the extent that air quality regulations may become more stringent in regards to the quantity and timing of smoke emissions, there could be substantial effects in limiting vegetation treatments using prescribed burning.

Shared border with Canada

The northern portion of the North Fork Geographic Area shares an international border with Canada. As such, there may be some impacts regarding the management of wildfires and whether or not the use of natural, unplanned ignitions is appropriate on the Forest when wildfires occur near the USA-Canadian border. As noted in the fire and fuels section, the general impact may is that some natural, unplanned ignitions that ignite on the Flathead Forest that may have otherwise been allowed to burn to meet resource objectives may become suppressed as a result of objectives or concerns raided by the Canadians. This could have a small negative impact on trending the forest vegetation on the Forest towards desired conditions, but the degree of this effect is unknown.

Adjacent non-national forest lands

Harvesting or conversion of forests on adjacent private and state lands will affect vegetation conditions at the landscape level, changing forest composition and structures. Forest pattern (patch sizes, shapes) would potentially be affected by treatments on non-NFS lands immediately adjacent to NFS lands. Old growth forest or very large trees may be removed on non-NFS lands, increasing the importance of retention on NFS lands. Forest conditions on adjacent lands may influence pattern, extent or intensity of natural disturbances within forests on NFS lands, for example fuel conditions/fire hazard or potential spread of insect/pathogen populations.

Adjacent state forest lands contain thousands of acres suitable for growth of western white pine, and restoration activities for this species are occurring on these state lands, including planting and precommercial thinning. The Stillwater State Forest (approximately 93,000 acres) and Swan River State Forest (approximately 56,000 acres) contain the bulk of western white pine habitat. Activities contribute to those occurring on national forest lands, and support the recovery of this species.

3.4 Carbon Sequestration

Introduction

Carbon sequestration and associated climate regulation has been identified as a key ecosystem service provided by the Forest. Guided by recommendations from the Council on Environmental Quality (CEQ), the Forest Service continues to develop principles and direction for consideration of biological carbon in land management and planning decisions. Climate impacts and GHG emissions are considered to be most important and meaningful to analyze at a forest or landscape scale, rather than an individual stand or site specific project area. This section of the EIS addresses and compares the potential effects of alternatives relative to carbon storage potential, and its association with greenhouse gas (GHG) emissions and climate change.

Legal/Administrative Framework

There are no applicable legal or regulatory requirements or established thresholds concerning management of forest carbon or greenhouse gas emissions.

The Council on Environmental Quality (CEQ) has issued revised draft guidelines for public consideration and comment on "Consideration of the Greenhouse Emissions and the Effects of Climate Change in NEPA Reviews" (Federal Register Volume 79, Number 247 page 77802). This draft guidance is not yet finalized, and public comment on this guidance is being solicited by CEQ. Never-the-less, the revised draft guidance was considered and the spirit of that guidance applied in assessing the carbon sequestration topic relative to the proposed revision of the Flathead Forest Plan.

Methodology, information sources and analysis area

Existing regional-scale climate projections are used to understand the type and magnitude of climate change effects that could occur. See the introduction to chapter 3 for a summary of projections and expected climatic changes relative to the Flathead National Forest.

Recent estimates of baseline carbon stocks and trends have been provided for forestlands on national forest land in the U.S. (USDA 2015). Estimates of forest carbon stocks are based on forest inventory data obtained from the Forest Service, Forest Inventory and Analysis (FIA) program. FIA is a national database of forest ecosystem data derived from field sample locations distributed systematically across the U.S., regardless of ownership or management emphasis (Bush et al. 2006). The Carbon Calculation Tool (CCT) estimates carbon stocks based on data from two or more years of inventories conducted since 1990 (Woodall et al. 2013). Carbon stocks are estimated by linear interpolation between survey years.

The affected area for effects related to carbon sequestration are lands administered by the Forest.

Incomplete and unavailable information

Estimates of future carbon stocks (e.g., stored carbon) and their trajectory over time will remain uncertain due to the uncertainty associated with the multiple interacting factors that influence carbon stocks and fluxes. This includes climate change and its effects on vegetation, which is difficult to predict, especially in the complex terrain and highly variable site conditions on the Flathead Forest. While advances have been made in accounting and documenting the relationship between greenhouse gases and global climate change, difficulties remain in reliably simulating and attributing observed temperature changes to natural or human causes at smaller than continental scales (IPCC 2007, pg. 72).

3.4.1 Affected Environment

Introduction

Forests cycle carbon. Forests are in a continual flux, emitting carbon into the atmosphere and removing it, i.e. storing it as biomass (sequestration). Carbon sequestration is the process by which atmospheric carbon dioxide is taken up by vegetation through photosynthesis and stored as carbon in biomass (tree trunks, branches, foliage and roots) and soils. Forests release carbon dioxide into the atmosphere as a result of respiration and decay of dead wood, litter and organic matter in soils. Tree mortality due to insects, disease, fire, drought or other factors increases the amount of biomass available for decomposition and carbon release by micro-organisms. In addition, forest fires release some stored carbon into the atmosphere in the combustion process. Timber harvest removes carbon from the forest, although some of it is stored in wood products or used to produce energy, displacing fossil fuel use. Over the long term, through one or more cycles of disturbance and regrowth (assuming the forest regenerates after the disturbance), net carbon storage is often zero, because re-growth of trees recovers the carbon lost in the disturbance and decomposition of vegetation killed by the disturbance (McKinley, et al. 2011; Ryan, et al. 2010; Kashian, et al. 2006).

Interest in carbon sequestration is increasing, related to efforts to find ways to mitigate for climate change world-wide by reducing atmospheric levels of “greenhouse gases” (which include carbon dioxide). The top three anthropogenic (human-caused) contributors to greenhouse gas emissions (from 1970-2004) are: fossil fuel combustion, deforestation, and agriculture (IPCC 2007, p. 36). Land use change, primarily the conversion of forests to other land uses (deforestation) is the second leading source of human-caused greenhouse gas emissions globally (Denman, et al. 2007, pg. 512). Loss of tropical forests of South America, Africa, and Southeast Asia is the largest source of land-use change emissions (Denman, et al. 2007, pg. 518; Houghton 2005).

The importance of carbon storage capacity of the world’s forests is tied to their role globally in removing atmospheric carbon that is contributing to ongoing global warming. Forests and other ecosystems are carbon sinks because, through photosynthesis, growing plants remove carbon dioxide from the atmosphere and store it. Sequestering, or storing, carbon in forest ecosystems can help to offset sources of carbon dioxide to the atmosphere, such as from fossil fuel combustion, deforestation, and agriculture.

Unlike other forest regions that are a net source of carbon to the atmosphere, U.S. forests are a strong net carbon sink, absorbing more carbon than they emit (Houghton 2003; US EPA 2013; Heath, et al. 2011). For the period 2000 to 2008, U.S. forests sequestered (removed from the atmosphere, net) approximately 481.1 teragrams (Tg) of carbon dioxide per year, with harvested wood products sequestering an additional 101 Tg per year (Heath et al 2011). Our National Forests accounted for approximately 30 percent of that net annual sequestration. National Forests contribute approximately 3 Tg carbon dioxide to the total stored in harvested wood products compared to about 92 Tg from harvest on private lands (Heath et al 2011). Within the U.S., land use conversion from forest to other uses (primarily for development or agriculture) are identified as the primary human activities exerting negative pressure on the carbon sink that currently exists in this country’s forests (McKinley, et al. 2011; Ryan, et al. 2010; Conant, et al. 2007). In contrast, forest lands on the Flathead National Forest will remain forests, and will not be converted to other land uses. Long-term forest services and benefits will be maintained.

Flathead National Forest ecosystem carbon

There are seven ecosystem carbon pools: above-ground live tree, below-ground live tree, understory, standing dead trees, down dead wood, forest floor, and soil organic carbon. These estimates indicate that total forest ecosystem carbon stocks (all seven carbon pools) on national forest lands in the Northern Region of the U.S. Forest Service have steadily increased over the past 20 years, beginning with 1,324 Tg (teragram) in 1990 and reaching 1,458 Tg in 2013.

The Flathead Forest has followed that same trend, contributing to this increase over time, as displayed in Figure 34. All the carbon pools follow a similar increasing trend. The above-ground live tree pool is storing the highest amount and the understory pool is storing the lowest. Between the two years, the highest percent increase in carbon storage occurred in the standing dead pool (approximately 38%), and the lowest in the below ground pool, approximately 6%.

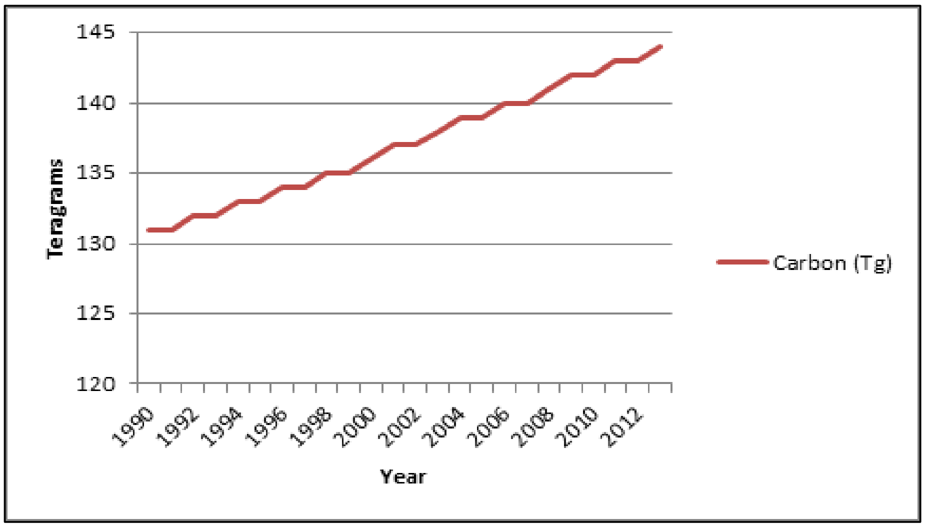


Figure 34. Total forest ecosystem carbon stocks on the Flathead National Forest from 1990 through 2013.

Harvested wood products

Carbon in harvested wood products contributes a small (about 5% of total carbon) but important portion of the overall carbon pool attributed to U.S. forest lands (USDA 2015). HWP are products made from wood including lumber, panels, paper, paperboard, and wood used for fuel (Skog 2008). The harvested wood products carbon pool includes both products in use and products that have been discarded to solid waste disposal sites. Additions to the harvested wood products pool are made through harvesting, while emissions are from decay and combustion of wood products.

The cumulative carbon stored in the Forest harvested wood products is displayed in figure 35. Carbon in harvested wood products includes both products that are still in use and carbon stored at solid waste disposals sites, including landfills and dumps (Stockmann et al. 2014). The variation over time is influenced primarily by changes in timber harvest levels. Harvested wood product carbon stocks have been relatively stable on the Forest after a peak in the 1990s.

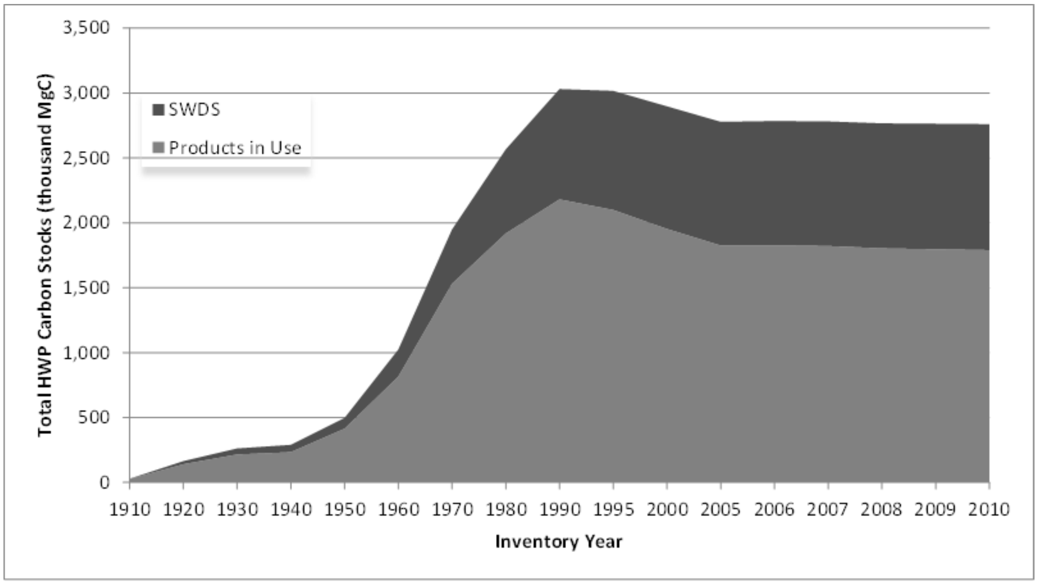


Figure 35. Cumulative total carbon stored in harvested wood products manufactured from Forest timber (Anderson et al 2013).

It is apparent that the Forest, to the best of our knowledge, is currently functioning as a carbon sink, storing more carbon than it releases, and on a steady upward trend that is likely to continue over the life of the plan. However, the long-term ability of the forests to persist as a net carbon sink is uncertain (Galik and Jackson 2009). Forests can be managed in a wide range of manners to sustain and perhaps increase their ability to remove carbon from the atmosphere. Management strategies applicable to the forests of the Flathead and to a comparison of alternative programmatic direction largely center on creating forest conditions that are resistant and resilient to disturbances that may occur with climate change. Drought stress, forest fires, insect outbreaks and other disturbances may substantially reduce existing carbon stock (Galik and Jackson 2009, Hicke et al 2012). Climate change threatens to amplify risks to forest carbon stocks by increasing the frequency, size, and severity of these disturbances (Dale, et al. 2001; Barton 2002; Breashears and Allen 2002; Westerling and Bryant 2008; Running 2006; Littell, et al. 2009; Boisvenue and Running 2010) (see also EIS Chapter 3 Introduction discussion on climate change). Recent research indicates that these risks may be particularly acute for forests of the Northern Rockies (Boisvenue and Running 2010). Increases in the severity of disturbances, combined with projected climatic changes, may limit post-disturbance forest regeneration, shift forests to non-forested vegetation, and possibly convert large areas from an existing carbon sink to a carbon source (Barton 2002; Savage and Mast 2005; Allen 2007; Strom and Fulé 2007; Kurz, et al. 2008a; Kurz, et al. 2008b; Galik and Jackson 2009).

Management actions that have the potential to increase forest resilience to the multiple stressors described above are often suggested “adaptation actions” and increase the likelihood of sustaining forest carbon benefits in the long term (Millar, et al. 2007; Joyce, et al. 2008; Ryan, et al. 2008b). Promoting resilience is the most commonly suggested adaptive option discussed in a climate-change context (Dale et al.2001, Price and Neville 2003, Spittlehouse and Stewart2003). Resilient forests are those that not only accommodate gradual changes related to climate but tend to return toward a prior condition after disturbance either naturally or with management assistance (Millar, et al. 2007).

Wildfire and extensive forest mortality as a result of insect and disease are primary sources of unintentional carbon emissions from forests in western United States (Stephens 2005), and can lead to widespread loss of centuries’ worth of carbon storage. This effect will likely be exacerbated in coming decades under continued warming, with increasingly severe fire years (Westerling et al. 2006). One obvious means of slowing this release of sequestered carbon is to increase forest resistance and resilience to fire, drought, insects and disease. In the forests of the Flathead, reducing potential for undesirable effects on forests from these disturbances and from climate change would be a primary component in a set of adaptation actions. This may include a variety of management strategies, with specific actions depending on site specific forest conditions. Management strategies would likely include reducing stand density and increasing the abundance and distribution of large diameter trees of fire resistant species. Refer to the vegetation section of this EIS for more detailed discussion of the vegetation conditions associated with resilient forests.

In addition to promoting forest resilience, mitigation measures have been suggested as additional options to reduce greenhouse gas emissions (Millar, et al. 2007). Options to increase carbon sequestration applicable to Flathead forests include measures that would also promote forest resilience, such as maintaining healthy, vigorous trees; manipulation of vegetation to favor rapid growth; keep sites fully occupied with trees with minimal spatial or temporal gaps in non-forest conditions; promoting reforestation; minimize severe disturbance by fire, insects and disease; and sequestering carbon after harvest in wood products (Harmon and Marks 2002, Kobziar andStephens 2006, Krankina and Harmon 2006).

3.4.2 Environmental Consequences

General effects for all alternatives

The future of the carbon sink of western U.S. forests, including the Flathead Forest, is uncertain due to the uncertainty associated with the multiple interacting factors that influence carbon stocks and fluxes (Lenihan et al. 2008a; Ryan et al. 2008; Birdsey et al. 2007). These factors include climate variability and change; potential positive effects of increased atmospheric CO2 concentrations on plant productivity; frequency, duration, and severity of moisture stress; changes in the rate and severity of natural disturbances; and land management practices (Canadell, Pataki et al. 2007). On the Forest, carbon stocks will vary over coming decades in response to the complex interactions between these factors and the changes they may cause in vegetation conditions. In addition, timber harvest practices will affect the quantity of carbon stored and both the ecosystem and forest products over time.

As discussed elsewhere, rates of net carbon sequestration in forests may be enhanced through management strategies that restore and maintain resilient forests that are better adapted to a changing climate and other stressors, and reforest lands disturbed by wildfires and other natural events. Harvested wood is also important when considering carbon benefits from forests. Treatments that generate long-lived wood products, such as lumber and furniture, transfer ecosystem carbon to the HWP carbon pool where carbon remains stored and doesn’t contribute to net greenhouse gas emissions. Substitution of wood for building materials that result in much higher greenhouse gas emissions, such as concrete, steel, or plastic, has a carbon emissions benefit. Forest vegetation treatments also generate excess material (woody biomass) which, if utilized, can be a renewable energy substitute for fossil fuels.

All alternatives incorporate an ecologically based approach to vegetation management, including direction to manage for vegetation conditions that would occur under a natural disturbance regime, and thus be more resilient in the face of future uncertainties. Fire and other natural disturbances are expected to occur over the next few decades to a similar degree under all alternatives (refer to the Vegetation and the Fire and Fuels section). Changes in forest composition, size classes, and other vegetation components over the next five decades are generally positive overall with regard to maintaining or increasing forest resilience (refer to Environmental Consequences under the Vegetation section of this EIS). This suggests that the Flathead Forest will continue to act as a carbon sink under all alternatives over the next few decades, sequestering (storing) more carbon than is lost through natural and human disturbance.

Effects of alternative A

The existing Forest Plan incorporates strategies to maintain resilient forests into the goals, standards and objectives for vegetation management and wildlife habitat. Unlike the action alternatives, the 1986 plan does not contain explicit or quantitative desired conditions for vegetation components, but rather provides more general direction that includes managing for vegetation conditions that would be expected to occur under natural disturbance regimes and to reduce the risk of undesirable fire, insect and pathogen disturbances. Most of this direction is located in the forest-wide objectives under section A(6)-Vegetation (pg. II-8, 1986 Forest Plan) and forest-wide standards under (H)-Vegetation (pg. II-47, 1986 Forest Plan). This direction would tend to trend the forest towards greater resiliency at both the stand and landscape scale, which would increase the likelihood of sustaining the forests' ability to sequester carbon over both the short and long term.

The existing forest plan contains no plan components or direct acknowledgment related to carbon stocks or sequestration.

Effects of alternatives B, C and D

As required by planning regulations (36 CFR 219.1), the strategy for vegetation management on the Flathead under the action alternatives is to provide for ecological sustainability and resilience, supporting a diversity of plant and animal communities, as well as providing for social and economic contributions to local communities. In response to this direction, desired conditions for key vegetation components were developed that describe, to the best of our ability, conditions that would maintain or improve forest and ecosystem resilience and promote the adaptability of vegetation. Though the forest plan provides direction for management of the forest over a relatively short period of time (the next 15 years), desired conditions were developed with the long term view in mind as well. This is necessary because ecological, social and economic sustainability concepts require a long-term perspective for appropriate interpretation and evaluation. The forest plan direction in the action alternatives provide more clarity and stronger integration of ecological concepts and management for resilient forest conditions than Alternative A.

Desired conditions for vegetation, and the standards and guidelines that help achieve or maintain the desired conditions, are the same in all action alternatives. The strategies incorporated into this direction are designed to maintain and create forests with the composition and structure that is able to accommodate gradual changes related to climate and tend to return toward a prior condition after disturbance (i.e., maintain resilience). Management tools available for use to achieve these desired forest conditions would also be the same between alternatives, and include the use of fire (wildfire and prescribed fire) and timber harvest. Planting and thinning in young forests to promote growth is also incorporated into the treatment prescriptions after both fire and harvest. Though the alternatives differ somewhat in the acres over which certain management tools (specifically prescribed fire and timber harvest) may be applied, the difference is likely to be inconsequential in regards to the differences in carbon sequestration.

As described at length in the vegetation section of this EIS, all action alternatives generally result in a similar and desirable trend towards improved forest resilience over the next five decade period. The forest plan direction in alternatives B, C and D, and the management strategies and tools to achieve desired conditions, are consistent with the adaptation actions described earlier for addressing concerns related to carbon and the role of forests as carbon sinks. All alternatives would thus increase the likelihood of sustaining the Flathead forests' ability to sequester carbon over both the short and long term.

All action alternatives include a desired condition addressing the sustainability of carbon storage and sequestration potential through maintenance or enhancement of biodiversity and function, and managing for resilient forests. Indirectly, all the plan direction associated with these concepts in the terrestrial vegetation section work towards achieving this desired condition.

3.4.3 Cumulative Effects

Within the U.S., land use conversions from forest to other uses (primarily for land development or agriculture) are identified as the primary human activities exerting negative pressure on the carbon sink that currently exists in this country's forests (McKinley, et al. 2011; Ryan, et al. 2010; Conant, et al. 2007). The Flathead Valley population is growing, and conversion of forest lands to non-forest purposes is likely to occur to some degree on private lands adjacent and nearby the Forest. However, the Flathead forest lands in this proposal would remain forests, not converted to other land uses, and long-term forest services and benefits would be maintained. The impact of the alternatives and proposed forest plan direction on atmospheric concentrations of greenhouse gasses or global warming is not likely to be large at the global scale, considering the global scale of the atmospheric greenhouse gas pool and the multitude of natural events and human activities contributing globally to that pool.

Federally owned forest lands are managed to ensure sustainable timber yields, and unlike other parts of the world, over-harvesting of timber is not a primary concern for decreased carbon sequestration (NRAP 2015). Sustainable management practices and promoting healthy, resilient forest ecosystems increase the ability of the forest to provide long-term carbon sequestering services (NRAP 2015).

An area of vulnerability to forest resilience and associated carbon sequestration and storage values is the increased risk of uncharacteristic fire, insect, and disease activity that might occur with climate change. Once a tree dies or loses a leaf or other plant part containing carbon, it will decompose and its sequestered carbon is either respired into the atmosphere or transformed into soil carbon. Thus, forests act as important carbon stores with regard to climate change. Large, high severity fires or large-scale insect outbreaks, can affect regional carbon stocks and flux within forest ecosystems. In the short term (decades), disturbances with high tree mortality can convert carbon sinks to a carbon source (Kurz, Stinson, and Rampley 2008; Kurz, Stinson et al. 2008; Kurz, Dymon et al. 2008). Over the long term (centuries), the effects of disturbances on the regional carbon balance are neutral, assuming similar vegetation regrows on the disturbed area and the long-term frequency and severity of disturbances does not change (Kashian et al. 2006; Canadell, Pataki et al. 2007). It is possible that over the very long term, climate changes may alter site conditions and disturbance patterns on the Flathead Forest to a degree that substantially impacts forest regrowth or vegetation types. This may reduce the Forest's capacity for carbon sequestration. This effect would be small in relation to global capacity to sequester carbon (NRAP 2015). The net effects on forest health and carbon sequestration have a high degree of uncertainty, primarily because of uncertainty in the magnitude of future climate change, and complex interactions of forest with disturbances, climate and ecological processes.

3.5 Plant Species

3.5.1 Plant species federally recognized as threatened, endangered, proposed or candidate

Introduction

This section covers plant species that are federally recognized under the Endangered Species Act as threatened, endangered, proposed, or candidate species. The Flathead Forest has two plant species that are listed as threatened and one species with candidate status.

Legal and administrative framework

Endangered Species Act (1973): Federal agencies are directed to conserve threatened and endangered species and to ensure that actions authorized, funded, or carried out by agencies are not likely to jeopardize the continued existence of these species, or result in the destruction or adverse modification of their critical habitats.

Code of Federal Regulations (CFR): 36 CFR 219.9(b)(1) – Planning Rule: States that the responsible official will evaluate whether the plan components provide the ecological conditions necessary to contribute to the recovery of federally listed species, conserve proposed and candidate species, and maintain a viable population of species of conservation concern in the plan area. Evaluation would consider components that provide for ecosystem integrity and diversity (coarse-filter approach) and species specific components (fine-filter approach).

Methodology and analysis process

The US Fish and Wildlife Service is responsible for determining species recognized under the ESA as threatened, endangered, proposed or candidate. Once identified, the Forest Service is responsible to manage for the ecological conditions that would contribute to the recovery of the listed species and conserve proposed and candidate species. Determining effects to federally-recognized species by alternative considers the degree of management activities or natural conditions that may pose potential stress or threat to the species.

Information sources and incomplete/unavailable information

Species federally recognized as threatened, endangered, proposed or candidate species for the Forest are those designated by the USDI, USFWS (USDI 2015). Federally recognized species have published information on species population trends, viability, threats, and conservation strategies. Though there may be uncertainties and gaps in data and knowledge about rare plant species, the best available information is utilized in this analysis to assess the existing condition and determining potential effects between alternatives. Primary information sources for information on plant species and their occurrences on the Forest are the Forest Service Natural Resource Manager (NRM) and Montana Natural Heritage Program (MNHP) Element Occurrence databases, which includes NatureServe database and the MNHP online Montana Field Guide. Information gaps may be filled in through future inventories, plan monitoring program results, or research, and this information would be integrated into the databases as it becomes available.

Analysis Area

The geographic scope of the analysis for effects to the threatened and candidate plant species in the planning area is the lands administered by the Forest. Range of a species may extend beyond the

Forest; however the lands administered by the Forest represent the area where changes may occur to these species or their habitats from activities that might be allowed under the alternatives.

Affected Environment

On the Forest, the two federally listed plant species that occur or are suspected to occur are water howellia and Spalding's catchfly. The candidate species is whitebark pine. An abbreviated discussion of the habitat, threats and population trends of these three species is documented below; additional detail can be found in the assessment.

Water howellia

Water howelliea (*Howellia aquatilis*), a vascular plant species in the family *Campanulaceae,* was listed as threatened under the ESA by the USFWS on July 14, 1994 (FR 59(134): 35860-35864)(USDI 1994). The USFWS drafted a recovery plan for the species (USDI 1996), but it has not been finalized. Therefore, there are no recovery goals officially identified for the species. A conservation strategy for water howellia on the Forest was completed (USDA 1997), incorporating strategies from the draft recovery plan and providing management direction to guide the conservation of the species. This strategy was incorporated into the current forest plan (amendment 20) and will be carried forward into the revised plan.

The USFWS completed a five year review on water howellia (USDI 2013). Existing federal regulatory mechanisms have protected water howellia habitat from human-caused impacts. It is due to these actions and continuing existing conservation practices that water howellia is recommended for delisting (USDI 2013).

Habitat

Water howellia is an aquatic plant restricted to small pothole ponds, or oxbows, long since isolated from the flowing surface waters of the adjacent river. These wetland habitats are generally shallow (approximately 40 inches deep during the early summer months). All of the howellia occurrences in the Swan Valley are in glacially formed ponds or retired river oxbows, usually surrounded in part by deciduous trees and a diverse matrix of coniferous forests (Lesica 1990).

Occurrence

Currently, there are 218 known populations of water howellia on the Forest, all in the Swan River Valley (NatureServe data base, MNHP)(USDI 2013). These 218 populations represent 72 percent of the known 304 global occurrences.

General surveys for water howellia in the Swan Valley have been conducted since 1987 and have continued to the present. The Flathead National Forest, with the cooperation of MNHP and The Nature Conservancy, has surveyed the majority of identifiable potential water howellia ponds in the Swan Valley. Many ponds that contain suitable habitat but are unoccupied by water howellia have been found in the Swan River Valley. Some initial identified suitable but unoccupied ponds have been later found to contain water howellia. Other identified suitable unoccupied ponds could harbor water howellia at some point in the future.

Threats

The National Heritage Program Network has ranked this species as G3, meaning that it is at a moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors (NatureServe 2014). The Montana Natural Heritage Program (MNHP) has ranked the species as S2, which means at risk because of very limited and potentially declining numbers, extent and/or habitat, making it vulnerable to global extinction or extirpation in the state. Water howellia is currently listed as threatened by the USFWS.

Water howellia habitat has been subject to various management activities including dredging, draining, road construction, logging, and grazing (Shelly 1988, USDA 1997). These activities could alter hydrological conditions by removal of vegetation or impacting soils. Resulting increased pond evaporation, changes in interception and transpiration of water by plants, and alteration of water flow in soils may influence water levels in ponds. This may be detrimental or beneficial to water howellia depending on the site specific situation. Sufficient drying of ponds is required in the fall for water howellia seed germination to take place (Lesica 1990).

The non-native variety of reed canarygrass (*Phalaris arundinacea*) has threatened some populations across its range, while not impacting other populations (Lesica 1997; USDI 2013). One howellia site, the Swan River Oxbox (The Nature Conservance preserve) does have documented encroachment of reed canarygrass that is likely an introduced cultivar from the adjacent National Wildlife Refuge, and impacts to that site have been published by Lesica (1997). The small isolated populations of reed canarygrass that occur in many of the howellia ponds in the Swan Valley may be native (Merigliano and Lesica, 1998) and a 10-year monitoring study (USDA 2008) did not show much expansion of reed canarygrass or any threat in the ponds.

Additional human caused threats to water howellia include potential drift from chemical spraying of invasive species near ponds. The effects of chemical controls conducted by state and private lands near water howellia ponds are unknown. The effects of herbicides at or near water howellia ponds on the Forest were analyzed in the Flathead National Forest Noxious and Invasive Weed Control Environmental Assessment and Decision Notice (USDA 2001). No chemical controls have been conducted at or near howellia ponds on the Forest. Surveys for at-risk plant species are required before conducting chemical control of invasive weeds on the Forest.

Natural disturbances that may affect water howellia include climate change, aquatic vegetation succession, and wildland fire. Changing climate patterns may affect the seasonal fluctuations in pond water levels that influence water howellia populations. Successive years of either dry, hot growing seasons or very wet, cool growing seasons could affect the annual filling and drying regime that is important to persistence of the populations. Vegetation succession in ponds could lead to extirpation of a population, if shifting from a pond to a sedge meadow. Wildland fire could have beneficial and detrimental effects to water howellia, depending on the situation. A hot fire late in the season could burn over seeds that are in shallow soil. Fire’s removal of trees and other vegetation surrounding ponds could have hydrological effects that alter water levels, with site-specific effects similar to the discussion on timber harvest above.

Trends

In 1998, a 10-year monitoring plan was initiated by the Forest to detect changes in water howellia distribution and abundance and was completed in 2007 (USDA 2008). This study assisted in evaluating if current management prescriptions for water howellia are sufficient for continued viability of the Swan Valley metapopulation. Approximately 65 occupied ponds were monitored annually over the ten year period. All populations, in both disturbed and undisturbed settings, persisted over that time, remaining very stable. Additional survey work has indicated a general increasing trend in the documented number of previously unknown populations in the Swan Valley, including occurrences of water howellia in previously unoccupied ponds. Population levels of water howellia are primarily influenced by annual fluctuations in precipitation and pond drying, with reduced population sizes often occurring during years following cooler, wetter summers. This is because the latter conditions inhibit fall seed germination (Lesica 1992).

The U.S. Fish and Wildlife Service concluded their five year review of water howellia in 2013 (USDI 2013). Their conclusion was that the threats identified at the time of listing have been mitigated through regulatory mechanisms such as the conservation strategy and incorporation of project design features that remove or minimize disturbance to populations, such as the 300 foot buffer around ponds for project level decisions. Other regulatory direction, such as buffers that limit ground disturbing activities around wetlands not occupied by water howellia, have also contributed to conservation of water howellia. Reed canary grass threatening ponds has been successfully treated in some states (USDI 2013) and does not seem to be invading other habitat as previously thought (USDA 2008). Grazing has been removed from water howellia habitat as well.

In addition to management changes to water howellia habitat, there have been almost 200 additional populations documented since the time of listing, including sites previously believed to be extirpated in Oregon and California. Because of all of these factors, the USFWS is recommending delisting water howellia, while maintaining current conservation measures (USDI 2013).

Spalding's catchfly

Spalding's catchfly (*Silene spaldingii*)is a perennial herb in the pink family (*Caryophyllaceae*). It was listed as threatened under the ESA by the USFWS on November 9, 2001 (FR 66(196): 51598-51606)(USFWS 2001). Although the USFWS intends to identify critical habitat for this species, critical habitat designation was precluded at the time of listing due to a lack of funding. The recovery plan for Spalding's catchfly (USFWS 2007) outlines the recovery strategy, and recovery goals, objectives and delisting criteria. A five year review was conducted by USFWS (2009). No change in listing was recommended due to lack of changes in the species status.

Habitat

Spalding's catchfly habitat is primarily dry grasslands and grassland inclusions typically dominated by rough fescue (*Festuca campestris*) or Idaho fescue (*Festuca idahoensis*), blue bunch wheat grass (*Pseudoroegneria spicata*), and other bunchgrasses. There may be scattered ponderosa pine trees, forming an open canopy. Plant communities dominated by these grass species are exceedingly rare on the Forest. A few patches of suitable habitat exist along the North Fork of the Flathead River floodplain from the Canadian border to Polebridge, in the Swan Valley, and in larger open fescue bunchgrass prairies in the South Fork Flathead and Danaher Creek Drainages within the Bob Marshall Wilderness. However, these areas have been surveyed extensively in the past and Spalding's catchfly was not found. There may be suitable grasslands in the Hog Heaven Range west of Flathead Lake and on the south slopes near Ashley Lake as well. None of these areas are specifically mapped; even so, they would comprise less than one percent of the land base of the Forest.

Occurrence

Spalding's catchfly is a Palouse Prairie endemic that is currently known from 107 populations across its range in Montana, Idaho, Oregon, Washington, and British Columbia. Populations are often small and isolated. Sixty-four occurrences are known from Montana, all in grassland plant communities located in the northwestern portion of the state. Numbers of individuals at most of these occurrences are very low. No populations are known from the Forest, though four occurrences are within three, 10 and 15 air miles from the forest.

Threats

This species has suffered considerable habitat loss and fragmentation due to agricultural and urban development, grazing, herbicide treatment, and exotic weed invasion (Schassberger 1988, Lichthardt 1997). There are no studies to date that evaluate the effects of disturbances such as grazing and trampling, though observations have been made that indicate grazing and trampling may have negative impacts (Lesica 1999, USFWS 2007). Invasion by exotic species threatens nearly all populations. The threat of herbicide drift is a factor affecting Idaho populations, though this is not a threat in Montana, as the few known Montana occurrences are geographically removed from agricultural treatments.

Trends

Populations of Spalding's catchfly have been extirpated in some portions of its range, and are stable in others, depending on the particular threats to each population (USFWS 2007). Due to the nature of the species' life history, population numbers vary from year to year. Many plants go dormant depending on climatic conditions. Some years exhibit tens of thousands of plants and other years, only a few hundred plants will be observed (USFWS 2007).

Whitebark pine

Whitebark pine (*Pinus albicaulis*), in the family Pinaceae, was determined by the USFWS to be a species warranted for federal listing but precluded under the ESA on July 19, 2011(FR 76(138): 42631-42654)(USFWS 2011). This makes the species a candidate for federal listing as threatened or endangered.

Range and occurrence

Whitebark pine is widely distributed throughout the coastal and Rocky Mountain ranges of western U.S. and Canada, though populations tend to be scattered and spotty because of the often discontinuous distribution of favorable high mountain habitat. It grows at the highest elevation of any western tree species. More than 90 percent of whitebark pine forests exist on public lands, including those managed by the Forest Service and National Park Service in the U.S. and by Provincial and Federal agencies in Canada (Keane et al, 2012).

On the Forest, sites capable of supporting whitebark pine are abundant in the upper slopes and ridges of the mountain ranges. The species grows on a wide variety of site conditions and forest settings, from mid and upper elevation moist slopes to cold, windswept, high elevation ridgetops. It tends to grow most successfully at the higher elevations and exposed, harsh sites where there is little competition from other species. Though it is most commonly found within the cold biophysical setting, it also grows successfully in coldest sites at upper elevation zones within the cool moist-moderately dry biophysical setting (refer to section 3.3.1 for description of biophysical settings), where it occurs in mixed species stands that often include lodgepole pine and subalpine fir.

The cold biophysical setting contains the most suitable whitebark pine habitat. From 50 to 80% of the area is the estimated natural range of variation for whitebark pine presence within this setting, which is the desired condition for the species presence in the revised plan (refer to section 3.3.4). The area within the cold biophysical setting totals approximately 335,300 acres, or 14% of the Forest, and therefore whitebark pine historically occurred on up to about 268,240 acres within the cold setting. Using the Forest Inventory and Analysis (FIA) database (refer to section 3.3, under Information Sources, and to exhibit xx for information on this database), whitebark pine is currently present on an estimated 134,750 acres of this setting, or about 40% of the area. This amount is below the desired condition, and reflects the stressors to this species that will be described in this section.

In the cool moist-moderately dry biophysical setting, the natural range of variation for whitebark pine presence is estimated at 6 to 16% of the area, or up to about 257,400 acres within this setting. Whitebark pine is currently estimated to occur on about 8% of this setting, or 128,700 acres (refer to section 3.3.4). This is within, though at the low end, of the natural range, and the desired condition is for this species to trend upward in presence within this setting.

Information on the character of the whitebark pine in the areas where it is present was also derived using FIA data. The average basal area of whitebark pine across the forest is currently estimated at 2.8 square feet per acre, and within the cold biophysical setting the estimate is 9.8 square feet per acre. These are extremely low values, indicating that there are very few whitebark pine present on the site and/or the trees that are present are small in diameter (i.e., seedling, sapling or small trees). FIA estimates of the trees per acre of larger diameter whitebark pine bear this out, with an average of only 6 whitebark pine trees per acre greater than 10 inches d.b.h. on the cold setting, and only one tree per acre greater than 15 inches d.b.h. About 40% of the acres have only seedling or sapling size whitebark pine present (less than 5 inches d.b.h.).

An additional analysis was conducted to add to our understanding of where and how much whitebark pine habitat may occur on the forest, as well as where this species might currently occur. This “Whitebark pine single-species mapping” project (Housman et al 2014) utilized modeling methods developed and being tested by Forest Service Region 1 remote sensing specialists, using a combination of field methods and image/terrain/climate variables. The Flathead Forest was chosen as a representative pilot study area for this analysis. Depending upon the model threshold range that is applied, the estimate of the potential range of whitebark pine from this analysis suggests that from 390,600 to 527,800 acres, about 16 to 22% of the Forest, is suitable for the successful establishment and growth of whitebark pine. This analysis also provides an estimate of the current occurrence of whitebark pine across the landscape. It suggests that the species is likely currently present (any size class) on most of these acres, though at exceedingly low densities (e.g., less than 3% of the total tree canopy cover on the site).

Species and plant community characteristics

Whitebark pine is a long-lived species, can live well over 400 years, with individuals over 1000 years known. It is moderately tolerant of shade, more tolerant than lodgepole pine but far less tolerant than other associates such as subalpine fir and spruce. Whitebark pine is slow growing in both height and diameter, reaching heights up to 60 feet or greater on the better sites, and rarely growing faster than most of its competitors except on the most severe sites (Arno and Hoff 1990).

Whitebark pine has fairly low resistance to fire damage, due to its thin bark. However, it is more resistant than its associates subalpine fir and spruce. Its deeper roots and more open crown form also enhance its resistance to fire. Larger mature trees are able to survive low intensity fires, but moderate intensity fires will kill many of these trees. High intensity fires are likely to kill even the largest whitebark pine (Keane and Arno, 1993). However, in areas with low fuel levels and more widely scattered trees, some whitebark pine may survive the higher intensity fires (Lorenz et al 2008).

Whitebark pine has a unique method of seed dispersal and regeneration, involving a mutualistic relationship that has evolved between whitebark pine and the Clark’s nutcracker (*Nucifraga columbiana*) for seed dissemination. Whitebark pine is entirely dependent on this bird to disperse and sow its seeds for regeneration of the species. Clark’s nutcracker benefits from the high quality food source provided by the large, nutritious seed of whitebark pine. The bird extracts the seed from the cones and, if not immediately consumed, they cache the seed in small stores often in the ground, sometimes many miles from their source. Unretrieved seeds that are buried in soil and on sites suitable for seed germination and establishment, such as open or fire-burned areas, are able to germinate, thus establishing new whitebark pine seedlings. Because of features unique to the whitebark pine cone, it is believed that the regeneration of this species on a population-wide scale is dependent on these birds (Lorenz et al 2008).

Whitebark pine grows in two types of high mountain forest settings: 1) as an early and mid-successional species on relatively moist sites, forming closed canopy forests, and eventually replaced through succession by more shade-tolerant tree species; and 2) as apparent climax species in pure or nearly pure stands, on relatively dry, cold slopes where it is the only tree species capable of successfully reproducing and growing to maturity. On the Forest, this latter forest type is least common, found only at the highest elevations and driest, coldest regions of the Swan and other mountain ranges in the upper reaches of the South Fork Flathead River watershed (in the Bob Marshall Wilderness). The majority of whitebark pine on the Forest occurs in the first type of high mountain settings, the mesic upper subalpine forests. On the best sites in these areas, whitebark pine grows in a straight, single-stem upright form, achieving heights of 60 or more feet. Stands may be densely stocked, forming closed or nearly closed canopy conditions. The lower range of whitebark pine overlaps with the upper elevational limit of lodgepole pine, and the two species may share dominance. Whitebark pine is an occasional species at even lower elevations within the subalpine forest type, where it may occur as a minor species within stands typically dominated by lodgepole pine and Douglas-fir.

Ecological role

Whitebark pine is considered a keystone species in upper subalpine forest ecosystems throughout its range. A keystone species performs an important ecological role or function, determining the ability for other species to persist, thus increasing the biodiversity of a community (Tomback et al 2001 and references therein). Most keystone species play a single important role in an ecosystem. In contrast, whitebark pine assumes multiple important ecological roles, due mainly to these key features: its large, nutritious seeds; its seed dispersal method; its hardy, robust seedlings; and its tolerance for cold, inhospitable, windy sites (McKinney and Tomback 2011).

Whitebark pine has the largest seeds of all conifers at subalpine elevations throughout its range. They are a highly nutritious food source for small birds and small mammals.

Whitebark pine becomes established very early in succession after a disturbance, such as fire, due to its highly effective seed dispersal method, as described earlier. Whitebark pine seedlings are exceptionally hardy, and more tolerant of exposed sites and drought than are the seedlings of associated conifers. Thus, not only is it frequently the first conifer to become established on disturbed sites, it has the greatest chance of survival in the often very harsh conditions within a burned area at higher elevations. The presence of whitebark pine facilitates the successional process by creating favorable microenvironments with shade, moisture and shelter from wind for establishment of other conifer species and understory vegetation.

Whitebark pine forests regulate runoff and reduce soil erosion because they are present at high elevations and on poor sites not tolerated by most other conifers (Tomback et al 2001 and references therein). In general, 35 to 60 percent of the annual precipitation at high elevations becomes runoff (Farnes 1990). Forest communities at high elevations, and whitebark pine in particular, accumulate more snow, slow the progression of snowmelt, and result in later melt-off and higher stream flows in summer months. Tree roots physically stabilize soils and take up water, also slowing runoff rates, and reducing soil erosion.

The structure and composition of whitebark pine communities vary considerably over its range and provide food, shelter, nesting sites, and a wide range of other values to a variety of animals. Few species appear restricted in distribution to whitebark pine communities, but the number of species summed over the wide variety of community types represent important contributions to forest biodiversity (Tomback et al 2001 and references therein). As described earlier, whitebark pine has higher tolerance to fire than subalpine fir or spruce, its primary conifer associates. This fact, along with the typical discontinuous, patchy fuel matrix of higher elevation forest, increases the probability that there will be surviving trees after a fire event in a whitebark pine community. These survivors not only facilitate more rapid reforestation of the landscape, they continue to provide habitat for wildlife.

In addition to the ecological role of whitebark pine, it should be noted that this species has an important social role as well. It could be called the "quintessential" high mountain conifer of the western North American landscape (Tomback et al 2001 and references therein), contributing in a variety of ways to the enjoyment or spiritual experience of the high mountain recreationist or traveler: the aesthetic beauty of the gnarled and windswept form of the trees on the horizon; the pastoral nature of open, park-like stands of whitebark pine; the welcome shade along a harsh ridgetop provided by their large, spreading tree crowns; the bird and squirrel activity they attract during the cone harvesting season.

Existing condition and threats

Several interrelated factors threaten the whitebark pine population, including: 1) past and ongoing fire suppression and exclusion; 2) mortality due to several major mountain pine beetle epidemics over the last 80 years; 3) extensive infections of the exotic pathogen white pine blister rust fungus (*Cronartium ribicola)*; and 4) effects of weather and climate, including climate change over time (Keane and Arno 1993, (Kendall and Keane 2001), USDI-FWS 2011). The effects and mortality caused by interaction of these factors are variable across the range of the species. In general, the greatest mortality is found in the more mesic parts of the range where upper subalpine forests experience a more maritime climate (Keane and Arno 1993). The Forest lies within this mesic portion and has experienced extremely high mortality of whitebark pine over the past 40 years.

Fire exclusion/suppression

Prior to about 1930, the replacement of whitebark pine by later successional species such as spruce and subalpine fir was usually interrupted by naturally occurring fires. Whitebark pine is exceptionally well adapted to re-establish after a fire event. However, decades of fire suppression have allowed subalpine fir and spruce to achieve dominance in many forests that were historically dominated by whitebark pine. This conversion is particularly significant in the moist subalpine forests of the Forest. Loss of whitebark pine due to disease or bark beetles has greatly exacerbated this conversion. Forests where whitebark pine were once the dominant species in the main canopy layer and the shade-tolerant spruce and subalpine fir mostly limited to the understory tree layers, now have little or no whitebark pine and are moderately to densely stocked with multiple sizes of subalpine fir and spruce. When a fire does occur, it tends to be more severe due to the increase in tree density, ladder fuels and downed woody material, and the overwhelming presence of non-fire resistant species. Though open, burned and favorable habitat for whitebark pine regeneration is created by the fire, the lack of cone-producing trees within caching distance severely limits the ability of this species to re-establish itself in areas where it historically was present or dominant. A recent study suggests that in highly damaged whitebark pine stands, most seeds produced are consumed by nutcrackers and red squirrels rather than dispersed (McKinney et al 2011).

Insects and disease

Several large, widespread epidemics of mountain pine beetle caused high mortality of whitebark pine throughout the U.S. Rocky Mountains between 1909 and 1940 and again from the 1970s to the 1980s (Arno and Hoff 1990 and references therein). Drought and warmer temperatures in recent years have allowed large increases in beetle abundance and distribution, again resulting in high mortality of trees in portions of .the range of whitebark pine.

White pine blister rust, a fungal disease caused by the pathogen *Cronartium ribicola*, is an introduced (non-native) disease which infects all 5-needled pines, which includes whitebark pine, and usually kills them. In addition, whitebark pine trees stressed by blister rust are more susceptible to attack by mountain pine beetle. Whitebark pine mortality from the combination of blister rust and mountain pine beetle exceeds 50% in areas of the U.S. intermountain northwest area, including the Flathead Forest. The high levels of mortality from bark beetles and blister rust have not only decreased the whitebark pine population, but have reduced the ability of the species to successfully re-establish in areas where it formerly occupied, due to loss of mature cone producing trees. Since blister rust kills individual branches years before the death of a tree, cone and seed production can be significantly reduced even though trees remain alive.

Climate change

The impact of projected climate change on whitebark pine is inconclusive, and there is an element of confusion in the research about the potential fate of the species (Keane et al, 2015, and references therein). Some feel that projected warmer conditions will severely reduce whitebark pine habitat or restrict it to only the highest elevations. Others feel that climate-mediated changes in disturbance regimes, such as increased fire frequencies, will reduce whitebark pine populations but not alter its current range. Anecdotal evidence suggests that some whitebark pine forests are experiencing abnormally high growth and more frequent cone crops with warmer summers and longer growing seasons (ibid 2015). The reality is more complex because of the high uncertainty in regional climate change predictions, the high genetic diversity and resilience of the species, and the localized changes in disturbance regimes and interactions.

Long-lived whitebark pine forests have experienced great variation in past climate and clearly have broad amplitudes of resilience with respect to climate (Keane et al 2015). Changes in disturbance regimes related to climate factors, and particularly the projected increase in number, area burned and severity of fire, may remove even more whitebark pine individuals from the landscape, especially if the fires are more severe due to altered forest conditions (as discussed earlier). However, these changes in fire regimes may actually favor the regeneration of whitebark pine, due to its fire-adaptations and seedling resilience. Whitebark pine may be maintained on the future landscape if large, stand-replacement fires reduce competition (ibid 2015). Seeds germinating within Clark's nutcracker caches will likely be from trees that have survived exposure to blister rust, and thus are more likely to have some level of natural resistance to the disease. However, within landscapes that have lost most of the cone-producing trees, the very low seed availability will slow this natural evolutionary process considerably. This seed availability is threatened even more by the susceptibility of these surviving trees that may have blister rust resistance to attack by mountain pine beetle. Unfortunately, warming temperatures may be beneficial to survival and expansion of mountain pine beetles, as well as the white pine blister rust fungus. Overall, whitebark pine is not expected to do well under future climates, primarily because of the current threats and severely declined population, its confinement to upper subalpine environments, and the lack of the ability to regenerate because of nutcracker predation of seed in areas of low whitebark pine populations (Keane et al 2015).

Trends

A severe and steep downward trend has been occurring in the whitebark pine population and health over the past few decades, especially in the Northern Rocky Mountains (Keane et al, 2012, with references therein). This decline is expected to continue into the foreseeable future, though the rate may lessen simply because there are fewer live trees left to be impacted by disease or other threats.

Studies in the 1990s that were specifically designed to document the presence and health of this species in western Montana estimated that an average of around half of the whitebark pine had died by that time (ranging from 30 to 90%), and up to 99% of the remaining trees were infected with blister rust (ranging from 20 to 99%) (Keane et al 1994; 2012). Recent re-measurement of a subset of these plots within the Bob Marshall Wilderness Complex show that mortality of whitebark pine trees has more than doubled in the past two decades, primarily as a result of blister rust infection and to a lesser extent mountain pine beetle and wildfire (Keane et al, 2015). Blister rust is now present in all surveyed stands, though infection rates have slowed since 1994. This could be due to a lack of living host trees coupled with some amount of natural rust resistance in remaining trees.

A similar study conducted in Canada and northern Montana also showed significant increases in the proportion of trees infected by blister rust and in mortality of whitebark pine (Smith et al 2008). The rates of infection appeared to be slowing, however, compared to the previous decades, suggesting some level of natural selection may be occurring. Fiedler and McKinney (2014) also reported high mortality of whitebark pine in recent decades in the Northern Continental Divide Ecosystem (which includes the Flathead Forest), with nearly three quarters of the whitebark pine trees dead and over 90% of the remaining live trees infected with blister rust. Even more ominous, there was a virtual absence of uninfected large (e.g. greater than 14 inch d.b.h.) cone-bearing whitebark pine, which makes the sustainability of this whitebark pine ecosystem more tenuous.

There is substantial concern over the ability of whitebark pine to successfully sustain itself within the ecosystem through natural regeneration. Some natural selection for resistance to blister rust is likely occurring (Hoff et al 2001), but the recovery of the species will be slow. Whitebark pine grows slowly and has a long generation time (60 to 80 years old before producing sizable cone crops), and as noted, there has been especially dramatic decline in mature, cone producing trees. The regeneration potential of the species is further exacerbated by evidence suggesting that stands with less than about 21 square feet per acre of live whitebark pine basal area provide too little cone production to reliably attract nutcracker seed dispersal (McKinney et al 2009). In addition, in areas with only a few surviving cone-producing trees, there is the risk of inbreeding depression. Trees that cross with themselves or close relatives produce seedlings that grow slower, are less hardy, and often exhibit lethal genes (Wright 1976). Unfortunately, some recent monitoring of the impacts of blister rust on whitebark pine natural regeneration on mesic sites in Idaho indicate high rates of infection and mortality of the young trees, with the number of live trees dropping by about 26% over a 17 year period (Schwandt et al 2013). More than 85% of the remaining live, infected trees are expected to die or be top-killed, removing any cone producing potential, by existing blister rust infections.

This data, combined with the results of modeling (as discussed under Range and Occurrence section above) and decades of field experience and observations by resource specialists on the Forest, substantiate the past and ongoing severe decline of whitebark pine in the planning area and the expectation that this decline will continue for some time into the future. There is an urgent need to focus on conservation and restoration efforts for this keystone species across the extent of its range and within the Forest (Keane et al. 2012).

Environmental consequences

Effects to water howellia and Spalding's catchfly

Alternatives A, B, C and D

Forest plan components comply with the requirements of the Endangered Species Act of 1973 (ESA). All federally recognized threatened, endangered and candidate species would continue to be managed and protected across the forest in accordance with Forest Service policy, recommended protection measures in the recovery plans (if available) and all applicable state and federal laws. Project-level analysis will evaluate site-specific impacts to these species, and consultation with the USFWS will take place for all projects potentially affecting threatened and endangered species. Additional design features or mitigation measures at the project level may be developed, if it is determined that they are needed.

All alternatives incorporate the elements from the conservation strategy for water howellia into forest plan direction, which are designed to provide protection from potential detrimental impacts from management activities and to maintain or improve habitat for this species.

The Condon Creek Botanical Area is recognized for its importance in protecting known populations of water howellia and given special designation under all alternatives. In the existing plan it is a "special interest area" (MA 3A) and in all action alternatives it is a "special area" (MA 3b). Forest plan components in all alternatives provide protection for the wetland habitat as well as the adjacent upland forested habitat within the Condon Creek Botanical Area. Components emphasize retaining the natural condition of these areas, supporting sustainable and healthy populations of water howellia, and providing educational and research opportunities where appropriate.

Though there are no known populations of Spalding's catchfly on the Forest, the dry grassland habitats where this species might occur would have low likelihood of notable impact from human activities. Timber harvest would not occur within this type; recreation use, such as hiking, may occur but has low likelihood of impact to the integrity of the plant community. Risk of invasive plant species poses the greatest threat to integrity of the dry grassland communities. Plan components that emphasize protection of high priority areas (including native grasslands) and treatments that focusses on these areas provide protection to these rare plant communities that serve as potential habitat for Spalding's catchfly (refer to FW-DC-NNIP-DC 01, FW-OBJ-NNIP-01).

Alternatives B, C and D

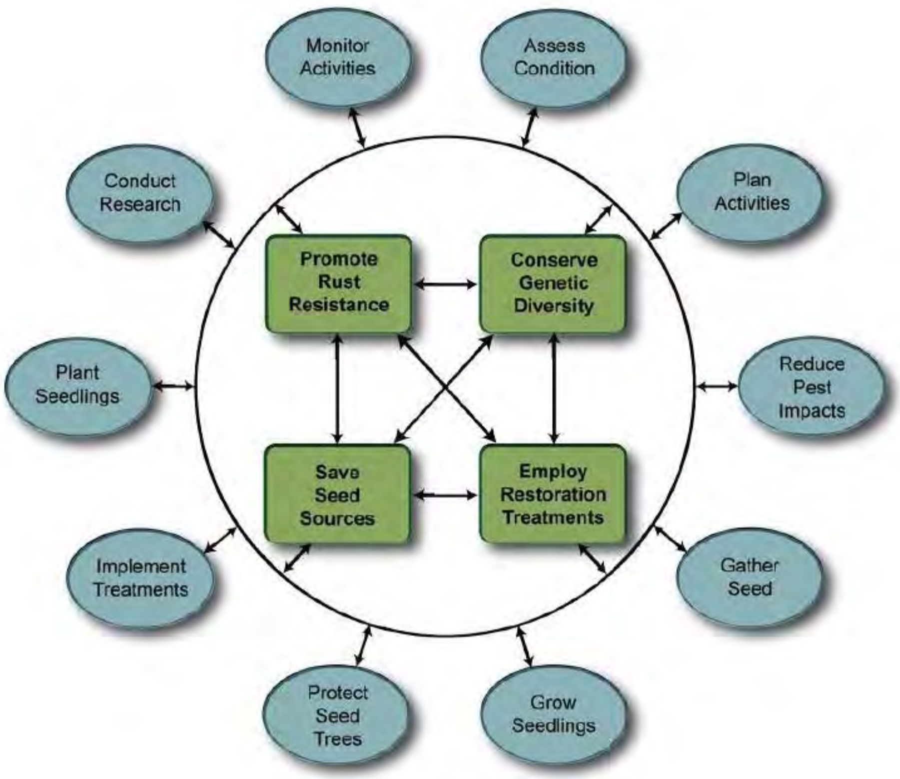
Additional protection is provided to water howellia habitat (occupied and unoccupied) in all action alternatives under the forest plan components associated with Riparian Management Zones (RMZs). A minimum 300 foot buffer would be applied to all mapped wetlands, which includes all known occupied water howellia sites, as well as unoccupied potential habitat. Within these RMZs, plan components address desired conditions and limitations on management activities to protect the values associated with the wetland. Please refer to the section on RMZs in the revised plan for description of these desired conditions, standards and guidelines.

Effects to whitebark pine common to all alternatives

Whitebark pine restoration strategy

Because the vast majority of whitebark pine forests occur on public lands, government land management agencies play key roles in ensuring the survival of this ecologically valuable tree species (Keane 2000; Tomback and Achuff 2010). In the interest of developing a coordinated strategy for whitebark pine restoration across its range, a strategy for conserving the species was developed based on integration of the latest scientific information (Keane et al, 2012). The hope is that this common plan could lead to more efficient use of scarce funds and expertise and more successful conservation and restoration of these species. The strategy consists of a set of four principles coupled with associated actions to guide restoration efforts throughout the species range. Figure 36 provides a display of this strategy.

Figure 36. The range-wide whitebark pine restoration strategy (Source: Keane et al 2012).



To contribute to range-wide restoration efforts, the design, planning and implementation of whitebark pine treatments on the Forest would be guided by the principles within this strategy under all alternatives. To the degree possible at the forest-wide scale, restoration efforts would be directed towards promoting rust resistance, conserving genetic diversity, saving seed sources and implementing restoration treatments.

Planting seedlings of rust resistant whitebark pine has been found to be an essential restoration activity for preventing local extirpation in some areas where high mortality has greatly reduced the number of mature seed producing whitebark pine (Keane and Parsons, 2010). This conditions occurs across much of the Forest. As described in the affected environment, the lack of seed in sufficient quantities to support Clark's nutcracker has greatly reduced the natural regeneration potential for any remaining whitebark pine. The Flathead has identified a total of 156 mature whitebark pine trees that display resistance to blister rust, from which cones, scion and pollen are collected to contribute to the restoration of the species (for example, seed is sown in nurseries to grow seedlings for planting). The Flathead has planted approximately 840 acres (about 168,000 seedlings) of whitebark pine across the Forest since planting began in the late 1990s.

Planting contributes to preserving the full genetic diversity across the range of whitebark pine (Mahalovich and Hipkins 2011). It is also important to have good spatial distribution across the forest of planting and other restoration efforts (i.e., seeding, thinning) for reasons that include lessening the risk of losing treated stands and valued seed sources to a single large fire. Planted whitebark pine contribute to the natural recovery of the species, by adding individuals that are more likely to be rust-resistant to the population, with greater probability they will survive to cone producing age and pass on their resistance to future generations. Blister rust resistance may be particularly important to the survival of the species into the future, if warming climate trends occur, which could favor blister rust.

However, there is not full agreement within the literature on the importance of artificially regenerating whitebark pine (i.e. planting or seeding). Landres (2010) put forth a more "hands off" approach and allowing whitebark pine to further decline, with the species adapting through natural selection. Logistical factors, specifically lack of reasonable access, limit the ability to plant in most of the areas where whitebark pine habitat occurs, though hand seeding may be another option to establish rust-resistant whitebark pine in areas of high mortality and would be more logistically feasible.

Use of fire (prescribed fire and wildfire) is an important tool in restoration efforts for whitebark pine. Recently burned areas provide the best, and sometimes the only areas where whitebark pine can be successfully planted and expected to survive. This is because fire creates the best growing conditions with the least competition from other vegetation (particularly other conifers) (Keane et al 2012). The Flathead had conducted prescribed burns designed specifically to contribute to whitebark pine restoration across an estimated 9700 acres since the late 1990s.

Thinning and fuel reduction in whitebark pine stands are important elements of the restoration strategy for whitebark pine, particularly in those areas where live, phenotypically rust-resistant whitebark pine trees still remain across the landscape. These activities remove competing tree species (i.e., subalpine fir, spruce), improves tree vigor and resistance to stressors, increases stand resistance to stand replacing fire, increasing the probability that whitebark pine (particularly the mature, cone producing trees) would survive a fire. The Flathead has conducted release/thinning projects to benefit whitebark pine across approximately 100 acres, with the first in 2009.

Restoration of whitebark pine is a long-term undertaking. Through natural selection, resistance to blister rust will slowly increase in the whitebark pine population across the forest over time. Planting (or seeding) will continue to establish small groups of trees with higher rust resistance scattered across the forest. Because of the physiological and ecological limitations, and the severe threats the species has been subjected to (as discussed above under Affected Environment), rapid and substantial improvement in condition of whitebark pine would not be expected over the relatively short 15 year life of the plan. However, purposeful and aggressive adoption of the whitebark pine restoration strategy, including strong support for active restoration treatments and protection of existing healthy whitebark pine, would improve the outlook for the species and more fully support its conservation, persistence and recovery in the ecosystem. Alternatives differ in the degree they facilitate active restoration efforts for whitebark pine, as described further in sections below.

Whitebark pine in designated wilderness

The Forest contains about 1,072,000 acres of designated wilderness, about 45% of the total Forest acres. A substantial amount (70%) of lands that are potentially capable of supporting whitebark pine on the Forest occur within designated wilderness (see table 25 below). Wilderness areas pose a challenge to whitebark pine restoration efforts, which is described well in the Range-wide Restoration Strategy (Keane et al 2012) and briefly summarized here. All alternatives would be equally subject to the challenges and limitations on whitebark pine restoration efforts within designated wilderness.

Designated wilderness direction greatly limits the application of whitebark pine restoration activities, particularly by not allowing planting or seeding, two activities increasingly recognized as essential to restoration efforts. In general, Forest Service policy does not allow for vegetative manipulation or broad-scale restoration actions in wilderness, except where the objectives cannot be met outside of wilderness, the loss is due to human influence, and there is no reasonable expectation that natural reforestation will occur. Currently the only activities related to whitebark pine restoration that are occurring in designated wilderness areas on the Flathead Forest are monitoring and inventory activities, and allowing unplanned fire ignitions to restore whitebark pine stands. Activities such as planting, direct seeding, mechanical thinning or prescribed fire would involve manipulation that is typically not allowed in designated wilderness. It should be recognized that such prohibitions have the potential to adversely impact restoration efforts for this species on the Flathead Forest. This effect would be the same for all alternatives.

Wilderness areas pose logistically challenging dilemmas for restoration due to lack of roads and prohibitions on motorized equipment and mechanical transport. There are also philosophical dilemmas about the compatibility of certain methods of restoration within wilderness areas, tied primarily to the definition of wilderness in the 1964 Wilderness Act. This definition is, "…an area where the earth and its community of life are untrammeled by man retaining its primeval character and influence managed so as to preserve its natural conditions and generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable" (Section 2 © P.L. 88-577). Untrammeled describes the untamed, free will aspects of wilderness, with the idea of allowing nature to take its course, without human manipulation. Based on this definition, any type of restoration could be considered "trammeling". However, the definition also states that wilderness is managed to preserve natural conditions. The dramatic decline and loss of a keystone species such as whitebark pine due to a non-native disease could be considered an unnatural condition. It could be argued that conservation and restoration efforts for this species should be allowed in order to restore natural conditions. However, it could also be argued that a more conservative approach should be taken, allowing the species to decline further and for nature to take its course.

Effects to whitebark pine by alternative

Refer to the Vegetation and Terrestrial Ecosystem section of this EIS, section 3.3.4 and section 3.3.10, for the evaluation of effects to whitebark pine dominance type and species presence over time by alternative, and effects related to resilience of forest ecosystems. The effects discussed in this section are related more directly to differences in management areas and forest plan direction as relevant to whitebark pine management and restoration programs.

Forest plan management direction

Alternative A – no action

Because of the recent designation of the species as a candidate for federal listing, the 1986 forest plan does not provide much recognition or direction related to restoration of whitebark pine across the Forest. However, threats to its survival and the need to encourage blister-rust resistance in the species is acknowledged, with several objectives in the current plan focused on promoting its regeneration on suitable sites. Under the stand-level guidance related to vegetation management (1986 Plan, page II-10 to II-11), objectives within the late seral/old growth forest state that treatments "that affect existing old growth should be limited to those necessary to promote regeneration of blister rust-resistant whitebark pine." In this same section, objectives within the mid and early seral forests focus on encouraging the establishment and development of blister-rust resistant whitebark pine through use of prescribed fire, mechanical treatments and planting of rust-resistant seedlings. Under forest-level grizzly bear direction, a guideline states that habitat management schemes should be considered to reestablish and maintain whitebark pine as a component of suitable habitat (1986 forest plan, page II-41).

Though there are not specific goals or desired conditions related to the desired presence of this species across the landscape, because it has been elevated to a candidate species status, this would provide some degree of additional attention and protection of whitebark pine in the existing forest plan, as compared to other tree species or forest types. Also, activities focused on whitebark pine restoration would continue to occur, guided by the range-wide restoration strategy described earlier.

Alternatives B, C, and D

The action alternatives provide strong support and specific direction that contribute to the protection and restoration of whitebark pine in the ecosystem. The action alternatives incorporate aspects of the range-wide conservation strategy described earlier in this section at the scale of the Forest. Forestwide direction associated with restoration of whitebark pine includes:

- Desired conditions that specifically strive to increase the presence and abundance of whitebark pine in the ecosystem, and to create habitat conditions that support the long-term persistence of this species in the ecosystem (FW-DC-TE&V-08, 09; FW-DC-PLANT-02).
- Objectives to treat up to 19,200 acres over the planning period for the purpose of sustaining or restoring whitebark pine in the ecosystem. These treatments would include thinning, planting, use of prescribed fire, seed collection, and stand treatments to protect phenotypically blister rust resistant mature trees (FW-OBJ-PLANT-01).
- Guidelines that provide protection of mature trees identified for cone collection purposes, that are confirmed or display characteristics of blister rust resistance (FW-GDL-PLANT-03).
- Monitoring of restoration activities and continuing to assess conditions of whitebark pine populations over time and success of treatments
- An exception added to the Northern Rockies Lynx Management Direction Standard VEG S6 which provides for "noncommercial felling of trees larger than sapling size within 200 feet of whitebark pine trees (in stands that contain trees identified for cone/scion/pollen collection), to make whitebark pine more likely to survive wildfires, more resistant to mountain pine beetle attack and more likely to persist in future environments" (FW-STD-TE&V-03).

In addition to this forestwide direction, the action alternatives have direction within the recommended wilderness areas (MA 1b) that would allow implementation of restoration activities associated with whitebark pine habitat (see section that follows). The plan components under all action alternatives will serve to increase the priority for restoration of whitebark pine on the forest and for continuing implementation of restoration activities, aiding in the recovery of this species and of high elevation whitebark pine plant communities.

Recommended wilderness (MA 1b)

Alternatives A, B and C propose areas for designation as recommended wilderness (no recommended wilderness is proposed in alternative D). Whitebark pine habitat occurs within most of the recommended wilderness areas. There may be potential effects to whitebark pine related to recommended wilderness, primarily associated with conducting restoration activities. Much of this potential effect is tied to the assumption that recommended wilderness areas are intended to be designated wilderness in the future by Congress. These effects are discussed in the cumulative effects section. Effects may also occur due to the potential for additional analysis, and public/agency involvement and scrutiny associated with proposal and implementation of vegetation restoration treatments within recommended wilderness, and associated increased costs of treatments. Table 25 displays the amount of whitebark pine habitat within both designated and recommended wilderness by alternative.

Table 24. Acres on Forest lands potentially capable of supporting whitebark pine within designated and recommended wilderness areas by alternative[a].

Potential whitebark pine areas	Alt A	Alt B	Alt C	Alt D
Total acres potentially capable of supporting whitebark pine, forest-wide	390,600 – 527,800	390,600 – 527,800	390,600 – 527,800	390,600 – 527,800
Acres of designated wilderness	1,072,040	1,072,040	1,072,040	1,072,040
Acres potentially capable of supporting whitebark pine within designated wilderness	273,500 - 367,400	273,500 - 367,400	273,500 - 367,400	273,500 - 367,400
Percent of total acres potentially capable of supporting whitebark pine that would occur within designated wilderness	70%	70%	70%	70%
Acres of recommended wilderness	98,388	187,741	506,919	0
Acres within recommended wilderness potentially capable of supporting whitebark pine	26,700 – 36,700	47,500 – 64,000	106,200 – 142,500	0
Percent of total acres potentially capable of supporting whitebark pine that would occur within recommended wilderness	7%	12%	27%	0
Acres outside both designated and potential wilderness areas potentially capable of supporting whitebark pine	90,400 – 123,700	69,600 – 96,400	10,900 – 17,900	117,100 – 160,400
Percent of total acres potentially capable of supporting whitebark pine that would occur both outside designated and recommended wilderness	23%	18%	3%	30%

Data from RSAC analysis conducted on the Flathead Forest (Housman et al, 2014)

Some of the existing whitebark pine restoration sites on the Flathead occur within recommended wilderness areas, specifically mature trees that have been identified for cone/scion/pollen collection (collection trees), and sites where whitebark pine seedlings have been planted (plantations). The collection trees are trees that display resistance to blister rust and contribute to the restoration program by providing the seed and other plant material, for example to grow seedlings in nurseries for planting. There are currently a total of 144 live whitebark pine trees in this program on the Flathead. Alternative A has no whitebark pine collection trees within recommended wilderness areas. Alternative B has three whitebark pine collection trees within recommended wilderness areas (in Slippery Bill and Tuchuck-Whale areas). Alternative C has fifty-eight collection trees within recommended wilderness (in Jewel Basin-Swan Crest, Limestone-Dean Ridge, Sky West, Slippery Bill-Puzzle, Coal, and Tuchuck-Whale areas). Alternative C also includes about 350 acres of whitebark pine plantations (nearly 40% of total acres planted) located in Jewel Basin-Swan Crest and Slippery Bill-Puzzle Creek recommended wilderness areas. Alternatives A and B include 150 acres of whitebark pine plantations (about 18% of total planted) in the Condon Creek area of the Swan Front recommended wilderness area.

Alternative A – no action

Recommended wilderness areas in the existing plan consist mostly of lands adjacent to the existing Bob Marshall Wilderness, expanding the size of this designated wilderness area. One additional recommended wilderness area of about 33,000 acres centers on the Jewel Basin Hiking Area. Alternative A does not include the Tuchuck-Whale area as recommended wilderness, a potentially desirable area for whitebark pine restoration (see discussion under alternative B below) and also contains whitebark pine collection trees.

Management direction for recommended wilderness in the existing plan is scarce, and consists of a forest-wide standard that directs management to be "consistent with the standards of the assigned non-wilderness management area designation, except that no action can occur which will reduce the areas' "wilderness attributes". When and if designated as wilderness by Congress, the existing plan directs management to be similar to current wilderness direction, except for the Jewel Basin area, which will continue with existing management until new direction is developed for this unique area.

As described earlier and displayed in Table 25, alternative A includes a relatively low amount of whitebark pine habitat within the recommended wilderness areas, and has one existing restoration site (plantation). This plantation was established under and consistent with current forest plan direction, which does not directly prohibit this type of activity. It would be assumed that maintenance of this plantation (e.g., future tending) would continue to occur under existing forest plan direction. Large areas of whitebark pine habitat occur outside recommended wilderness in alternative A, and would remain available for implementation of the full suite of whitebark pine restoration activities. These areas are well distributed across the landscape. Primarily because of this, recommended wilderness designations would likely have minimal adverse impact on whitebark pine restoration efforts on the Flathead. See cumulative effects section for potential effects with future wilderness designation.

Alternatives B and C

Desired conditions for recommended wilderness in alternatives B and C specify that these areas are to "preserve opportunities for inclusion in the National Wilderness Preservation System", with "limited amount of human influence" and the desire to "maintain and protect the ecological and social characteristics that provide the basis for each area's suitability for wilderness recommendation" (Revised Forest Plan, MA 1b Desired Conditions). As evident from Table 25, whitebark pine is a major component of the recommended wilderness areas. As described earlier, whitebark pine fills an important ecological role, and the dramatic decline of this species has had far-reaching impacts across the high elevation ecosystems.

Alternatives B and C provide direction that explicitly states recommended wilderness areas are "suitable for restoration activities where the outcomes will protect the wilderness characteristics of the areas as long as the ecological and social characteristics that provide the basis for each area's suitability for wilderness recommendation are maintained and protected". The intention of this revised forest plan direction is to provide flexibility to address needs for whitebark pine restoration within the recommended wilderness areas, because these areas contain nearly all of the potential whitebark pine sites on the FNF outside of designated wilderness. They also contain ongoing restoration sites as discussed earlier (plantations and cone collection trees). This direction and the identification of whitebark pine as a key ecological component of the recommended wilderness areas, would provide support for application of restoration activities within the recommended wilderness areas, if determined through a site-specific analysis to be a necessary and important component of the forest-wide and range-wide restoration strategy for the species.

The potential restoration activities that may be allowed within recommended wilderness (but currently not allowed in designated wilderness) under forestwide direction in alternatives B and C include prescribed fire (e.g. to create sites for regeneration of whitebark pine or reduce competition from other conifers); planting (or seeding) of whitebark pine seedlings; hand thinning (e.g., use of chainsaws to daylight thin around seedling or sapling whitebark pine trees); and protecting phenotypically superior seed producing whitebark pine trees from loss due to fire, bark beetles, or other stressors (e.g., use of chainsaws to reduce fuels and encroaching trees around mature whitebark pine cone producing trees).

Use of fire is anticipated to be an important tool that will be used to achieve desired vegetation conditions and maintain natural ecological processes within some of the recommended wilderness areas. As mentioned earlier, recently burned areas provide the best sites to plant or seed whitebark pine. Use of unplanned ignitions (wildfire) to achieve desired conditions is feasible in large, continuous landscapes (such as the Bob Marshall/Great Bear wilderness areas) where fire has room to spread naturally, and there is lower level of threat to values at risk. However, use of unplanned ignitions would be difficult in smaller landscapes or in areas where prevailing winds and other factors would threaten private lands or other values at risk. This situation exists in some of the recommended wilderness areas in both alternatives B and C. Thus the use of prescribed fire (planned ignitions) would be particularly important to maintaining and restoring whitebark pine in these recommended wilderness areas.

Both alternatives B and C would contribute positively towards the whitebark pine restoration efforts on the Flathead, due to the forest plan direction that retains the opportunity to conduct whitebark pine restoration activities where deemed necessary, while the area remains designated as recommended wilderness. Refer to discussion under cumulative effects for potential impacts when these areas are designated wilderness.

Alternative D

This alternative has no recommended wilderness allocation and would have no effect on whitebark pine restoration efforts associated with this allocation.

Consequences to threatened and candidate plant species from forest plan components associated with other resource programs or revision topics

Effects from access (motorized and non-motorized) and recreation uses

Water howellia could potentially be affected by recreation activities that could cause ground disturbance, such as hiking/trampling, biking, dispersed camping and off-road vehicle use, particularly during periods where pond water levels are low and the habitat is more vulnerable to disturbance. Roads and trails for recreational use can contribute to the spread of noxious weeds. Alternatives that provide opportunity for increased recreational access would have greater potential for disturbance of water howellia habitat. Most known water howellia habitat is located in the valley bottom areas of the Swan Valley; all alternatives are similar in the amount and type of recreational opportunities that could potentially occur in this area, and thus similar potential for recreational impacts to water howellia habitat. Recreational uses would have little to no effect on whitebark pine populations.

Effects from vegetation management

Vegetation management treatments can have impacts to plants and plant habitat through canopy removal and soil disturbance. As discussed earlier in this section, forest canopy removal through fire over large areas could alter hydrological conditions, influencing water levels in water howellia ponds. The plants within the Northern Rockies have evolved under a fire-dominated ecosystem, and the use of fire as emphasized under the action alternatives should not in and of itself pose a threat to plant populations. Vegetation treatment may require road building or maintenance. Roads increase access and provide an avenue for invasive plant species. Alternative C would have the least amount of vegetation treatments, and thus the least potential for impacts to water howellia. Alternatives A, B and D are relatively similar in vegetation treatment amounts, and would have a slightly larger potential of impact. All alternatives incorporate the conservation strategy for howellia and have plan components that protect habitat and contribute to conservation of the species, as described earlier in this section.

The use of vegetation management (e.g., prescribed fire, planting, etc.) is a key component of the whitebark pine restoration strategy, used as a tool to promote the conservation of the species and its persistence on the landscape. The types of treatments that may be implemented have been described earlier. Such restoration treatments will have long term beneficial effects to the persistence of the species and its contribution to the resiliency of high elevation plant communities on the Flathead.

Effects from non-native invasive plants

Introduced, invasive plant species can displace native plants through competitive displacement. Indirect impacts include herbicide spraying and mechanical ground disturbance to control noxious weeds once they gain a foothold. Competition from invasive non-native species and noxious weeds can result in the loss of habitat, loss of pollinators, and decreased rare plant species viability. Roads, trails, livestock, and canopy reduction can provide ideal pathways for the introduction of exotic and non-native species. Indirectly, herbicide spraying can affect populations of native pollinators by contaminating nesting materials and pollen resources, further decreasing the viability and reproductive success of rare species. Regarding the risk of weed invasions and/or expansion of populations, the alternatives would vary in some ways. In general, the more emphasis the alternative has on active, ground disturbing management the greater the likelihood of weed spread. Therefore, alternative D has a greater potential for impact, followed by alternative B, with the least potential under alternative C. All alternatives incorporate similar direction that guides treatment of invasives, based on the forest-wide analysis and decision for noxious weeds that was incorporated into the existing and revised forest plan direction (refer to Invasive Plant section). An integrated management approach to weed control is applied. The action alternatives have specific objectives for acres of invasive plants to treat, providing even more focus on control efforts.

Effects from future wilderness designation of recommended wilderness areas

Uncertainty exists as to the degree of flexibility in whitebark pine restoration efforts that would be allowed to occur in the future in the recommended wilderness areas, once they are designated as wilderness by Congress. As designated wilderness, these areas could be subject fully to the current limitations and prohibitions in designated wilderness for certain whitebark pine restoration activities, as described earlier in this section. This would have an adverse effect on whitebark pine restoration efforts on the Forest. The degree of effect would vary depending upon the amount of whitebark pine habitat and the existing areas where ongoing whitebark pine restoration activities are occurring within the recommended wilderness areas by alternative, as well as the quality, distribution and accessibility of the habitat. As shown Table 25, the action alternatives differ substantially in the amount of acres of whitebark pine habitat within recommended wilderness, and thus in the potential effect to restoration efforts in the future when areas are designated wilderness. Effects by alternative are discussed below.

Alternative A

Alternative A has the least amount of recommended wilderness areas (except for alternative D, which has none), and most of the areas lie adjacent to the existing Bob Marshall Wilderness. About one quarter of the whitebark pine habitat outside designated wilderness is incorporated in recommended wilderness. About 152 acres of whitebark pine plantation lies within the Swan Front recommended wilderness area. Because of the relatively low amount of whitebark pine habitat within the recommended wilderness and its location, alternative A would have relatively low impact on future whiteark pine restoration opportunities. The main detrimental impact would be on the ability to maintain the existing plantation, such as through thinning. Use of hand tools rather than chainsaws may be required.

Alternative B

Of the alternatives, alternative B would include the second largest amount of acres within recommended wilderness. This alternatives includes about half the remaining acres of whitebark pine sites outside designated wilderness in recommended wilderness allocations, including some important and relatively accessible known habitat. Also included within alternative B recommended wilderness areas are the whitebark pine plantation described under alternative A, and three identified cone/scion/pollen collection trees.

In addition to the recommended wilderness areas in alternative A, alternative B includes more acres in the Jewel Basin area as well as larger areas adjacent to the Bob Marshall Wilderness and a large block of over 80,000 acres in the upper portion of the North Fork GA (Tuchuck-Whale recommended wilderness). Some of the recommended wilderness areas in alternative B contain relatively accessible whitebark pine habitat (such as the Swan Front and portions of Tuchuck-Whale). In addition, Tuchuck-Whale recommended wilderness area contains some of the most extensive and vigorous whitebark pine populations known to occur on the Forest (outside designated wilderness). The extent of this population and the role it may play in future restoration efforts, is not fully known, but it may well prove to be a priority site for seed collection or restoration treatments.

In contrast to the very large expanses of the Bob Marshall Wilderness and the recommended wilderness areas that lie adjacent to the Bob, the opportunity to use unplanned fire ignitions (wildfire) to achieve desired vegetation conditions would be very limited in the Tuchuck-Whale area. This recommended wilderness area lies adjacent to Canada, which increases complexity of fire management considerably. Fires in the vegetation types in this area are typically high severity, wind driven fire events which the prevailing winds would likely spread into the private lands in the valley bottom, not to mention into Canada. Use of planned ignitions would thus be particularly key to maintaining and restoring whitebark pine, as well as other vegetation conditions, within this recommended wilderness area in particular.

Because of the location of recommended wilderness, the acreage of whitebark pine sites they contain, the relative accessibility of the areas, and the inclusion of the whitebark pine plantations and collection trees, alternative B would have a greater potential for long-term adverse effects on whitebark pine restoration effort than alternative A, though less than alternative C.

Alternative C

Alternative C includes the largest amount of acres in recommended wilderness, encompassing nearly all of the potential whitebark pine habitat on the Forest that occurs outside designated wilderness. It also includes about 40% of the both the existing whitebark pine planted acres and identified cone/scion/pollen collection trees. As with alternative B, recommended wilderness in this alternative includes some of the potentially more desirable areas for whitebark pine restoration areas. It also includes numerous other areas both within the North Fork and in other GAs where the use of unplanned ignitions (wildfire) as a method to both restore whitebark pine and create desired vegetation conditions would be very limited, due to adjacent values at risk. The loss of ability to use prescribed fire as a tool would be detrimental to restoring whitebark pine and achieving other desired ecosystem conditions. For all these reasons, alternative C would have the greatest potential long-term adverse effect on whitebark pine restoration efforts.

Alternative D

There are no acres proposed as recommended wilderness, and thus would have the greatest long term opportunities and least potential for future restrictions of whitebark pine restoration activities due to wilderness designations.

Cumulative effects

Public lands play a critical role in the conservation of threatened, endangered, proposed and candidate plant species. During the next several decades, human populations are likely to expand, which will likely result in greater human presence and pressure on public lands, for example for recreational uses. These trends suggest not only that public land will play an increasingly important role in the conservation of these species in the future, but also that management to ensure recovery and/or prevention of federal listing of species will be an increasingly difficult challenge.

The results of surveys and monitoring indicate that water howellia populations are persisting and sustainable future (refer to discussion under “Trends” in Affected Environment section earlier). Effects of climate change on whitebark pine will also likely occur. However, specific changes in ecosystem components due to expected climate change are difficult to predict, as described in earlier sections on climate (Keane et al 2015).

In the Northern Rockies ecosystem, the vast majority of whitebark pine forests occur on public lands, which includes the Forest Service and National Park Service in the U.S. and Provincial and Federal agencies in Canada (Keane et al, 2012). Public land management will play a very important role in the restoration of this species. Coordination between public land managers is key to effective and efficient restoration efforts. Climate change is likely to cause shifts in the range of whitebark pine, with changes in wildfire a catalyst for those shifts (Keane and others (2015).

3.5.2 Plant species of conservation concern

Introduction

A species of conservation concern (SCC) is a species, other than federally recognized threatened, endangered, proposed, or candidate species, that is known to occur in the plan area and for which the regional forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long-term in the plan area (36 CFR 219.9). This section covers plant species that are designated as species of conservation concern (SCC) by the Regional Forester for the action alternatives B, C and D. Public comment during scoping for the proposed action also expressed interest in knowing the status and effects to plant species previously listed as sensitive by the Regional Forester, but not determined to be a species of conservation concern for the Flathead NF DEIS. Effects to plant species in this category is disclosed within this section of the EIS as well. Federally recognized threatened, endangered, proposed and candidate plant species are covered in the section 3.5.1 of this EIS.

Legal and administrative framework

The National Forest Management Act (NFMA) of 1976: "It is the policy of the Congress that all forested lands in the NFS shall be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yields. Plans developed shall provide for the diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet the overall multiple-use objectives, and within the multiple-use objective."

Code of Federal Regulations (CFR): 36 CFR 219.9(b)(1) – Planning Rule: States that the responsible official will evaluate whether the plan components provide the ecological conditions necessary to contribute to the recovery of federally listed species, conserve proposed and candidate species, and maintain a viable population of species of conservation concern in the plan area. Evaluation would consider components that provide for ecosystem integrity and diversity (coarse-filter approach) and species specific components (fine-filter approach).

Methodology and analysis process

The USFS regional forester has the responsibility for identifying the species of conservation concern for each planning unit. Criteria for identifying and evaluating species for SCC is outlined in the 2012 planning rule and directives (USDA 2015 FSH 1909.12.52). Refer also to section 3.7.3 in Wildlife for discussion on the process for identifying species of conservation concern.

Plant species analyzed were placed into appropriate habitat groups, based on their similarity of habitat requirements and use of similar resources. Determining effects to plant species for each alternative considers the degree of management activities or natural conditions that may pose potential stress to the species. During the planning process, each key ecosystem characteristic was evaluated and determinations made on whether associated SCC plant species needs were met by emerging plan components, considering known locations of species and their habitats, as well as key drivers/stressors. Additional species-specific plan components were then considered and developed if needed.

Information sources and incomplete/unavailable information

Primary information sources used are the Forest Service Natural Resource Manager (NRM) and Montana Natural Heritage Program (MNHP) Element Occurrence databases, including NatureServe and the MNHP online Montana Field Guide.

Though federally listed species (i.e., threatened and endangered species) have published information on species population trends, viability, threats, and conservation strategies, the majority of plant species in the NRM and MNHP databases do not. Most information on these plants are derived from expert opinion and/or panel consensus, specifically at biannual meetings held by the Montana Native Plant Society in conjunction with the MNHP. There is little published information about most rare plant species concerning their viability, biology, habitat, population dynamics, occurrences, etc. Though there are uncertainties and gaps in data and knowledge about most rare plant species, the best available information is utilized in this analysis to assess the existing condition and determining potential effects between alternatives. Information gaps relevant to at-risk species may be filled in through future inventories, plan monitoring program results, or research, and this information would be integrated into the databases as it becomes available.

Analysis Area

The geographic scope of the analysis for effects to native plant species is the lands administered by the Forest. Range of a species may extend beyond the Forest; however the lands administered by the Forest represent the area where changes may occur to these species or their habitats from activities that might be allowed under the alternatives.

Affected environment

Plant species have been grouped for purposes of analysis, based on broad similarity of habitat they occupy. The list of all plant species that are analyzed in this DEIS, including species previously listed as sensitive plants known to occur on the Flathead, is located in appendix D. Though there may be variation in specific habitat needs for species within a group, the potential stressors and associated conservation strategies for the species in the habitat group would be very similar, allowing for more efficient analysis and identification of relevant information pertaining to the species. Table 26 displays the list of plant species of conservation concern as designated by the regional forester for the DEIS, as well as provides some information on habitat of the species. Description of the habitat groups follows.

Table 25. Species of conservation concern designated by the regional forest on the Flathead National Forest for the draft EIS, with information on habitat and stressors.

	Name	Habitat	Primary Stressors
	FEN HABITAT GROUP		
1	*Amerorchis rotundifolia* Roundleaf orchid	Spruce forest around seeps or along streams, often in soil derived from limestone.	Changes to hydrology and canopy cover; riparian zone disturbances; collection
2	*Carex chordorrhiza* Creeping Sedge	Wet, organic soil of fens in the montane zone.	Competition with invasive vegetation; changes to hydrology
3	*Carex lacustris* Lake-bank Sedge	Marshes and fens.	Changes to hydrology
4	*Cypripedium passerinum* Sparrow's-egg Lady's-slipper	Mossy, moist, or seepy places in coniferous forests, often on calcareous substrates.	Main stressor to populations appears to be from potential hydrologic changes; road construction; riparian zone disturbances; collection
5	*Drosera linearis* Slenderleaf Sundew	Wet, organic soil of nutrient-poor fens in the montane zone. Resides in specialized, limited habitat (wilderness and RNA).	Loss of peatland habitat through drainage or peat mining. Logging and trampling by visitors can also damage populations of this species. Changes to hydrology
6	*Eleocharis rostellata* Beaked Spikerush	Wet, often alkaline soils, associated with warm springs or fens in the valley and foothills zones.	Vulnerable to hydrologic alteration and development.
7	*Eriophorum gracile* Slender Cottongrass	Wet, organic soil of fens from low to moderate elevations.	Vulnerable to activities that may alter the hydrology of occupied sites.
8	*Liparis loeselii* Loesel's Twayblade	Wet, organic soils of calcareous fens in the valley and montane zones.	Somewhat threatened by land-use conversion, habitat fragmentation, and forest management practices; unknown causes of decline appear to be a factor as well. Changes to hydrology
9	*Lycopodium inundatum* Northern Bog Clubmoss	Wet, organic soil of nutrient-poor fens in the valley and lower montane zones.	Land-use conversion, habitat fragmentation, wetland drainage, and succession are considered low-level stressors. Changes to hydrology
10	*Meesia triquetra* Meesia moss	Collected on forest from fen and peat dome at base of slope, fed by perennial springs, collected from shallow pool and wet lawn. Also found at edge of pond in the wilderness.	Changes to hydrology
11	*Scorpidium scorpioides* Scorpidium moss	Found on wet soil in calcareous seeps and fens.	Changes to hydrology

	Name	Habitat	Primary Stressors
12	*Sphagnum magellanicum* Magellan's Peatmoss	Rich fens, peatlands (Schofield 1992)	Changes to hydrology. Peat mining.
13	*Trichophorum cespitosum* Tufted Club-rush	Wet meadows and sphagnum-dominated fens in the montane to alpine zones.	Air pollution is a potential stressor in high elevation habitats. Changes to hydrology
	WETLAND/RIPARIAN HABITAT GROUP		
14	*Dryopteris cristata* Crested shieldfern	Moist to wet, often organic soils at the forest margins of fens and swamps in the montane zone.	Land-use conversion and habitat fragmentation via the alteration of wetland habitats. Timber harvest in the northern portion of its range. Changes to hydrology; road construction; riparian zone disturbances
15	*Epipactis gigantea* Giant Helleborine	Stream banks, lake margins, fens with springs and seeps, often near thermal waters.	Recreation, exotic species, water development, livestock grazing, urban development, timber harvest, and utility line maintenance. Changes to hydrology; road construction and maintenance; riparian zone disturbances.
16	*Petasites frigidus var. frigidus* Arctic Sweet Coltsfoot	Swamps, fen margins, and riparian seeps within open forest and meadows in the valley and foothill zones.	Riparian zone disturbances; changes to hydrology; road construction; timber harvest
	MESIC MONTANE, DISTURBANCE, ROCK/TALUS/SCREE HABITAT GROUP		
17	*Botrychium paradoxum* Peculiar Moonwort	Mesic meadows associated with spruce and lodgepole pine forests in the montane and subalpine zones; also found in springy western red cedar forests.	Grazing, trampling and off-road vehicle use.
18	*Botrychium pedunculosum* Stalked Moonwort	Various mesic sites from valley bottoms to the montane zone. The most common habitats are western red cedar bottomlands.	Cattle grazing, road building and maintenance, timber harvesting (incl. use of sites as staging areas), and recreational activities such as camping, horse riding, and ORV use. Fire suppression on some sites, which is allowing succession to proceed.
19	*Collema curtisporum* Jelly Lichen	Moist riparian forests, often in narrow sheltered valleys. Substrate is the trunk (bark) of *Populus trichocarpa* (black cottonwood); occasionally on conifer twigs.	Timber harvest; riparian zone disturbances; change in native fire regime; stand-replacing fires
20	*Corydalis sempervirens* Pale Corydalis	Montane; rocky, disturbed or eroding soil of steep slopes in open forest, often appearing after fire.	Main stressor appears to be from fire exclusion. Invasive plant species, timber harvest and vegetation succession also stressors.

	Name	Habitat	Primary Stressors
21	*Cypripedium fasciculatum* Clustered Lady's-slipper	Montana occurrences are mostly in warm moist forests	Timber harvest, road construction, development, fire suppression, change in native fire regime, stand-replacing fires, and collecting. Also possibly stressed by surface disturbances and canopy elimination.
22	*Grimmia brittoniae* Britton's dry rock moss	Shaded cliff faces	Endemic to Northwest Montana, one of the rarest mosses of interior Pacific Northwest and one of only a few narrow endemics in the region known at this time. Threatened by proposed highway widening. Relatively low elevation habitat puts this species at some risk from human activities.
23	*Grindelia howellii* Howell's Gumweed	Vernally moist, lightly disturbed soil adjacent to ponds and marshes, as well as similar human-created habitats, such as roadsides and grazed pastures.	Invasive weeds are a stressor to many occurrences, as the habitat occupied by this species is also favorable for many weedy species. Application of herbicides along roadsides, grazing, road construction and maintenance, and change in native fire regime also.
24	*Idahoa scapigera* Scalepod	Vernally moist, open soil on rock ledges in the lower montane zone.	Invasive weeds, primarily spotted knapweed and cheatgrass, as well as hydrological changes.
25	*Mimulus breviflorus* Short-flowered Monkeyflower	Shallow, vernally moist soil among rock outcrops in coniferous forests or grasslands in the montane zone.	Soil disturbance; changes to hydrology; timber harvest activities and road construction.

The list of plant species previously identified as sensitive and known to occur on the Flathead Forest, and their associated habitats, is located in tables D-5 through D-9 in appendix D of the draft revised forest plan. There are a total of 40 species previously identified as sensitive, with 23 of these designated by the Regional Forester as SCC for the Draft EIS. Of the remaining 17 plant species previously identified as sensitive, eleven fall within habitat groups that are also associated with the identified plant SCC. Stressors and effects to these species would be similar to those disclosed for the SCC species within the group. Additionally, there are six species previously identified as sensitive within habitat groups that have no identified SCC – two within the aquatic habitat group and two within the alpine habitat group.

Stressors to plant species

Fen (peatlands) habitat group

This habitat group contains species associated with peatlands, specifically fens, which are groundwater-dependent wetlands with accumulating organic matter (Chadde et al 1998). Fens form where high water tables and permanent saturation slow rates of decomposition, and soils are formed from accumulating partially decayed organic matter. Fens are fed by surface water or groundwater, and may be mineral rich or poor depending on the surrounding bedrock. They are usually dominated by grasses, sedges and mosses, but frequently have a high diversity of other plant species.

Thirteen plant species of conservation concern are included in this group, all restricted to fen habitats or areas of wet organic soils. In addition, four plant species previously identified as sensitive and known to occur on the Flathead NF are within this group (see table D-5 in appendix D). Fen habitats are relatively rare and occupy small, isolated areas on the Flathead and surrounding lands. Fen associated plant species are vulnerable to disturbances and stressors, including changing climatic conditions, fire, and hydrologic changes. Stressors and ecological processes that may influence their habitats apply to all species. These include:

- Management actions or natural processes that alter hydrologic regimes, such as draining of wetlands or ditching, changes in adjacent forest communities, climate changes;
- Management activities that disturb soils adjacent to wetlands and may affect water quality: such as road construction, reconstruction, and maintenance activities that result in runoff; livestock use; herbicide application; and sedimentation from timber harvest activities;
- Invasive plant species;

Wetland/riparian habitat group

This habitat group is composed of species that predominantly inhabit marshes or the very moist forested areas associated with riparian areas. Marshes are wetlands with standing water, and have emergent vegetation that is rooted in mineral soil. Three plant SCC occur in this group. In addition, two species previously identified as sensitive plant species and known to occur on the Flathead are within this group (see table D-7 in appendix D). Stressors and ecological processes that may influence these habitats include:

- Management activities that disturb soils and vegetation within riparian areas or adjacent to wetlands, such as road construction, reconstruction, and maintenance; livestock use
- Fire disturbances/exclusion as they change vegetation conditions in riparian areas and vegetation adjacent to wetlands
- Invasive plant species; invasive plant treatments

- Recreation use, trails, visitor trampling, camping in riparian areas.
- Flooding events
- Natural succession of wetlands
- Climate change may also affect species in this group, insofar as it may alter stream flows, timing of snow melt, and other hydrological factors.

Mesic montane, rock/talus/scree, disturbance habitat group

This habitat group is composed of species that inhabit upland forested sites, openings, rock outcrops, or disturbed settings. Nine plant SCC are within this habitat group. Most are associated broadly with mesic forests or meadows, often near/in riparian areas, at various elevations from valley bottoms to mid-elevation zones. A few are associated with rocky sites and/or disturbed soils, either due to natural (such as fire) or human-caused actions. One species is associated with warm, dry forest types. In addition to these SCC, five plant species previously identified as sensitive and known to occur on the Flathead are within this group (see table D-9 in appendix D).

Stressors and ecological processes that influence upland forested habitats apply to all species to varying degrees. These include:

- Vegetation treatments (logging, prescribed fire, etc.);
- Fire disturbances and fire exclusion/suppression;
- Natural succession;
- Cattle grazing, trampling
- Construction of roads and other developments
- Recreational activities, such as trails, camping and off road vehicle use, that could disturb or trample plants
- Invasive plant species and treatment of infestations

Collecting of the showy clustered lady-slipper is also a stress specific to that species.

Climate change may also affect plant species in this group. Increased temperature and prolonged summer drought conditions may increase risk of desiccation. Increased fire severity or frequency may also affect habitat for these species, either favorably or detrimentally depending upon their habitat requirements.

Aquatic habitat group

There are no SCC designated within this habitat group. Four species previously identified as sensitive plant species and known to occur on the Flathead are within this group, generally occurring in shallow water associated with lakes, ponds, and rivers in the valley and montane zones (see table D-6 in appendix D). Stressors to these species would be similar to those associated with fens and wetlands, including changes in hydrology or water quality that might occur either from natural or human caused sources.

Alpine habitat group

There are no SCC designated within this habitat group. Two species previously identified as sensitive and known to occur on the Flathead are within this group (see table D-8 in appendix D). These species generally occur on exposed ridges and slopes in alpine and subalpine zones. There is generally few stressors to species associated with this habitat, due to the remote habitats, and mostly associated with recreational uses (such as trail construction). Changes in fire patterns and severities, and associated effects on vegetation succession may be a stressor in some environments. Refer to section 3.5.1 under the discussion on whitebark pine for additional information on forest conditions and changes in high alpine habitats due to the loss of much of the whitebark pine component.

Environmental consequences

Alternative A – no action

The current plan includes standards designed to protect rare plant species (1986 Forest Plan section II, Forest-wide standards, Section F-9 Rare Plants and F-10-Sensitive Species), which would be applied to the plant species previously identified as sensitive. Standards direct that adverse impacts to rare plants or their habitats should be avoided. If impacts cannot be avoided, the significance of potential adverse impacts will be analyzed. Project decisions are directed to not result in loss of species viability or create significant trends towards federal listing. The no action alternative requires inventories and preparation of biological evaluations for project decisions, to determine potential effects to rare plant species.

Alternatives B, C, and D

To ensure the conservation of plant species of conservation concern (see Table 26 for list of SCC species) and protect these species and associated plant communities from potential detrimental impacts from management activities, Forest-wide management direction has been developed and would be implemented under all action alternatives. Some of this specifically addresses needs of the SCC species and is located in the SCC section of the plan; some direction provides protection to the site and habitats associated with SCC species and is located in other sections of the plan (such as riparian management zone and soils sections). Plan components that ensure the conservation of plant SCC include desired conditions that support maintaining the ecological processes and vegetation conditions that contribute to the conservation of these species (FW-DC-PLANT SCC-01, FW-DC-WTR-11, FW-DC-WTR-15); providing mitigation and protection measures to maintain species and habitats during planning and implementation of activities that may impact them (FS-GDL-PLANT SCC-01); standards and guidelines that provide management direction within riparian management zones (RMZs) and wetlands that will also provide protection to plant SCC associated with these habitats (FW-STD-RMZ-02, FW-GDL-RMZ-01 through 10, FW-DC-WL SCC-01, FW-DC-WL SOI-01, 02); and standards and guidelines that provide protect soils from undesirable disturbance during management activities (FW-STD-SOIL-01; FW-GDL-SOIL-01 through 04).

The standard for designation of buffers (RMZs) adjacent to streams and wetlands will protect plant SCC associated with fen and wetland habitat (FW-STD-RMZ-01). Width of the buffer for mapped ponds, lakes, reservoirs and wetlands is a minimum 300 feet, which is greater than the minimum 150 feet interim RHCA widths specified in the existing plan for ponds and wetlands greater than 1 acre (category 3 RHCA/RMZs). Refer to Aquatic Ecosystems section of the plan and this DEIS.

Management direction for water howellia includes a standard for retention of a minimum 300 foot buffer from the margins of occupied and unoccupied ponds, and guidelines limiting ground disturbing activities within this buffer (FW-STD-PLANT-01, FW-GDL-PLANT-02). These measures will also provide protection for plant SCC associated with this habitat.

Fens support unique and very diverse plant communities, including many plant SCC, and RMZ buffer widths on all fens would be a minimum 300 feet, as described above for category 3 RMZs. In addition, the action alternatives have further acknowledged the special botanical features associated with fens by designation of eleven Special Areas (management area 3b) that focus on the more distinctive fen complexes on the Forest. In addition to the forestwide plan components described above, the Special Areas have components that emphasize retaining the natural conditions of these areas (MA3b-Special

Area-DC-01); protecting them from invasive plant species and human disturbances that may adversely affect their special characters (MA3b-Special Area-DC-02, (MA3b-Special Area-GDL-01). Taken together, the plan components related to plant conservation should result in protection and retention of habitat associated with SCC species in the plan area.

Over half (23 out of 40) of the plant species previously identified as sensitive that are known to occur on the Flathead Forest have been designated as SCC by the Regional Forester for the Draft EIS, and effects have already been discussed above. As mentioned earlier, of the remaining 17 plant species previously identified as sensitive, eleven fall within habitat groups associated with the plant SCC: four within the fen group, two within the wetland/riparian group, and five within the mesic/disturbance/rockland group. The protections provided by plan components to SCC and their habitats as described earlier would also protect other plant species and communities (including species previously identified as sensitive) that occupy these types of habitats.

Habitat for the four species previously identified as sensitive and associated with open water (aquatic habitat) is protected by plan components that address the conditions of aquatic ecosystems on the Forest. These include desired conditions, and supporting standards and guidelines, to provide for resilient, diverse and sustainable aquatic plant and animal communities, maintain water quality, the physical integrity and flow of streams, and aquatic ecosystems free of invasive species (see Watershed section of the draft revised forest plan). These measures should adequately protect plant species previously identified as sensitive associated with this habitat and result in low risk of impact..

There would be little to no risk of impact to the two plant species previously identified as sensitive that are associated with high elevation alpine sites. Areas where they grow are remote, with limited potential for human disturbance. Plan components associated with restoration of the alpine-associated whitebark pine plant communities would benefit other plant species associated with alpine habitats (refer to whitebark pine discussion in section 3.5.1).

Consequences to species of conservation concern from forest plan components associated with other resource programs or revision topics

Effects from recreation

Recreation impacts can include ground disturbance, trampling, removal of individuals, and introduction of weeds, both by hikers and off-road vehicle use. The development of campgrounds and other facilities used by recreationists also contribute to plant habitat impacts, as these developments make more areas accessible and concentrate use. Dispersed camping and recreation have similar impacts. Parking areas, particularly undesignated areas, pose similar impacts to plants. In addition, there can be long-term impacts of bisecting a rare plant population with a trail or other linear feature and affecting the reproduction and/or plant dispersal. Other recreational impacts include off-road vehicle use, which can also disturb soil, affecting both occupied and unoccupied suitable habitat. Roads and trails for recreational use can contribute to the spread of noxious weeds. These potential impacts are most likely to affect plant species of concern associated with upland terrestrial habitats, rather than those in fens or marshes. All alternatives are similar in the kinds and amounts of non-motorized recreational uses, and thus would be similar in potential effects. Because of the widely dispersed nature of these recreational uses, impacts are expected to be low on SCC plants. As for motorized recreational use, alternative C would have the least potential impact, because it will decrease the opportunity for off-road motorized use the most (refer to Recreation section of this EIS). Alternative A would also have a similar impact as alternative C, with the most roads reclaimed/decommissioned among the alternatives, as well as a reduction in current amount of motorized trails. Alternatives B and D would have the most potential impact, which would be essentially status quo, with little if any change in current motorized use across the forest. The action alternatives differ from alternative A because they contain specific plan components designed to protect plant species of concern and provide protection measures for site-specific proposed projects.

Effects from vegetation management and road access

Vegetation management treatments can have impacts to plants and plant habitat through canopy removal and soil disturbance. In addition, vegetation treatment may require road building or maintenance. Roads used for vegetation management increase access and provide an avenue for invasive plant species. Roads may be placed through riparian areas, which are important habitats for a number of species. Sudden changes in forest conditions may cause damage to individual plants immediately, such as through light stress and ground disturbance. An abundance of early successional forest reduces the available habitats for those plants that require mid-to-late successional stages. However, those disturbance-dependent species that prefer openings, early-successional stages, or some ground disturbance, could benefit from moderate levels of activities after a few years. Plants within this ecosystem have evolved and are adapted to the conditions created by fires of all severities, and the use of fire as emphasized under the action alternatives would create suitable habitat over time for rare plant populations. Fire creates favorable conditions for some species, not so favorable for others. However, if species are rare due to very limited habitat, or human-caused stressors, loss of habitat or populations due to fire may be of concern. Alternative C would have the least amount of vegetation treatments and associated roads, and thus the least potential for impacts to plant species of concern. Alternative A, B and D have similar amounts of vegetation treatments, but alternative A would reclaim/decommission the most amount of road among the alternatives which, over the long term, reduce stressors to species of concern associated with roads. Alternative A would be second to alternative C in potential for impact. Alternatives B and D are relatively similar in vegetation treatment amounts, and would have the most potential for impact to species of concern associated with vegetation treatments and access roads. For all alternatives, plan components are designed to protect plant species of concern from impacts associated with these activities, and anticipated effects are expected to be low.

Effects from non-native invasive plants

Non-native invasive plant species can displace native plant communities through resource competition. Impacts from management activities include herbicide spraying and mechanical ground disturbance to control noxious weeds once they gain a foothold. Competition from invasive weeds can result in the loss of habitat, loss of pollinators, decreased native plant diversity, and decreased rare plant species viability. Roads, trails, livestock, and canopy reduction can provide ideal pathways for the introduction of non-native species. Regarding the risk of weed invasions and/or expansion of populations, the alternatives would vary in some ways. In general, the more emphasis the alternative has on active management the greater the risk of weed spread and establishment. All alternatives incorporate similar direction that guides treatment of invasive plants, based on the forest-wide analysis and decision for noxious weeds that was incorporated into the existing and revised forest plan direction (refer to Non-native Invasive Plant section). An integrated management approach to weed control is applied. The action alternatives have specific objectives for acres of invasive plants to treat, providing even more focus on control efforts.

Cumulative effects common to all alternatives

Public lands play a critical role in the conservation of plant species of conservation concern. During the next several decades, human populations are likely to expand, which will likely result in greater human presence and pressure on public lands, for example for recreational uses. These trends suggest not only that public land will play an increasingly important role in the conservation of these species in the future, but also that management to ensure prevention of federal listing of species will be an increasingly difficult challenge.

3.6 Non-native Invasive Plants

3.6.1 Introduction

A plant species is considered to be an invasive plant if it meets two criteria: 1) it is nonnative to the ecosystem under consideration, and 2) its introduction causes, or is likely to cause, economic or environmental harm or harm to human health (Executive Order 13112, 1999). Non-native invasive plants include exotic plants and noxious weeds. Exotic plants are species that have been introduced inadvertently or intentionally to an area, usually from a different continent; however, not all exotic species are invasive species.

The term noxious weed is a legal designation and is defined by Montana Code Annotated (MCA 7-22-2101, 2014) as, "any exotic plant species established or that may be introduced in the state that may render land unfit for agriculture, forestry, livestock, wildlife, or other beneficial uses or that may harm native plant communities."

While invasive plants are often adapted to habitats where they are not native, they lack the natural controls (insects, disease) they may have evolved within their native ranges. As a result, they tend to spread aggressively and reduce overall native community diversity, and generally disrupt the natural processes of the environment. They displace native plants or reduce forage for some animal species, degrade natural communities, change hydrology, change microclimatic features, increase soil erosion, alter wildfire intensity and frequency, and cost millions of dollars in treatments and fire suppression to land management agencies and governments (USDA APHIS 2001).

3.6.2 Legal and administrative framework

Federal law

The Federal Noxious Weed Act of 1974 states that each federal agency shall establish and adequately fund an undesirable plant management program; complete and implement cooperative agreements with state agencies regarding the management of undesirable plant species on federal lands under the agency's jurisdiction; and establish an integrated management system to control or contain undesirable plant species targeted under cooperative agreements.

The Federal Insecticide Fungicide and Rodenticide Act (Public Law 92-516) requires all pesticides to be registered with the Environmental Protection Agency. It also states that it is unlawful to use any registered pesticide in a manner inconsistent with its labeling.

The Carlson-Foley Act of 1968 (Public Law 90-583) authorizes and directs heads of Federal Departments and Agencies to permit control of noxious plants by State and local governments on a reimbursement basis in connection with similar and acceptable weed control programs being carried out on adjacent non-federal land. In other words, this act permits county and state officials to manage noxious weeds with herbicides on Federal lands and to be reimbursed for that management, given that other applicable laws such as the National Environmental Policy Act are also met.

The Federal Land Policy and Management Act of 1976 (Public Law 94-579) provides authority to control weeds on rangelands as part of a rangeland improvement program.

Executive orders

Executive Order 13112: Directs federal agencies to prevent the introduction of invasive species; detect and respond rapidly to and control populations of such species in a cost-effective and environmentally-sound manner; to monitor invasive species populations accurately and reliably; to provide for restoration of native species and habitat conditions in ecosystems that have been invaded; to conduct research on invasive species and develop technologies to prevent introduction; to provide for environmentally sound control of invasive species; and to promote public education on invasive species and the means to address them. All of these actions are subject to the availability of appropriations.

State and local law

The State of Montana County Noxious Weed Management Act states that it is unlawful for any person to permit any noxious weed to propagate or go to seed on the person's land, except that any person who adheres to the noxious weed management program of the person's weed management district or who has entered into and is in compliance with a noxious weed management agreement is considered to be in compliance with this section.

Other regulation, policy, and guidance

Forest Service Manual (FSM) 2900: Ensures that forest management activities are designed to minimize or eliminate the possibility of establishment or spread of invasive species on NFS lands, or to adjacent areas.

FSM 2070 Vegetation Ecology: Provides direction for the use of native and non-native seed use on National Forest System Lands. Specifically emphasizes the use of native seed mixes in all revegetation, rehabilitation and restoration projects on Forest Service.

Forest Service National Strategic Framework for Invasive Species Management (2013) (http://www.fs.fed.us/invasivespecies/framework.shtml): Provides broad and consistent strategic direction on the prevention, detection, and control of invasive species. Incorporates the Invasive Species Systems Approach to respond to threats over the next 5 to 10 years.

3.6.3 Indicators, methodology and analysis process

The following are indicators used for the analysis of invasive species:

- Vegetation treatments
- Motorized use and access
- Recreational activities
- Livestock grazing
- Fire activity

Effects to invasive species is indicated by evaluating the difference in frequency, intensity, or type of management activity or natural processes by alternative, insofar as they may potentially disturb the ground and result in greater risk of weed spread or invasion. The process for identifying risk and impacts resulting from invasive species is completed by Forest Service botanists and vegetation specialists.

3.6.4 Information sources, and incomplete or unavailable information

The Forest Service uses the Montana Noxious Weed List (2013), collaboration with county weed coordinators, and the results of project-specific invasive plant risk assessments to identify invasive species needing management across the forests. As project areas are surveyed, new infestations are inventoried. Existing data on invasive species is stored in the Natural Resource Manager’s Threatened, Endangered, and Sensitive Plants, and Invasive Species database (NRM-TESP-IS).This data base is continually updated with inventoried infestations. Refer to the Assessment for summaries of multiple years of data from Natural Resource Manager queries, risk assessments, and field observations. The current condition and trend of invasive plants on the Flathead National Forest is also summarized in the Assessment.

There are many areas of the forest that have not yet been inventoried for invasive species infestations. Wilderness and research natural areas are examples of areas that are not well inventoried. There is also a lack of information on areas that are weed-free, especially in vegetation types at highest risk. The Natural Resources Manager database is continually updated with field observations that are reported by project personnel.

3.6.5 Analysis area

The geographic scope of the analysis for non-native invasive plants is the NFS lands of the Flathead National Forest. This area represents the NFS lands where changes may occur to vegetation as a result of management activities or natural events. For cumulative effects, the analysis area also includes the non-NFS lands within and immediately adjacent to the administrative boundary of the Flathead National Forest.

3.6.6 Affected Environment

As reported in the Assessment, as of 2014 there are nearly 10,000 separately recorded invasive plant infestations on the forest, comprised of approximately 30 invasive species. These records include revisits to known infestations. The majority of these sites are in road corridors, gravel pits, and log landings. In the Swan Valley, many dense infestations were found on the recently acquired lands (formerly Plum Creek Timber Company), which added to the forest-wide weed inventory considerably.

On a landscape scale, the Flathead National Forest has been less affected than many other public lands as most invasive species are best adapted to grasslands, shrub lands, and warmer/drier forest types, and such habitats are limited in extent on the Forest. However, the forest has many roads, landings, clearings, gravel pits, trails, campgrounds, private inholdings, and other areas that are disturbed and highly susceptible to infestation. Weed infestations in such areas are potential seed sources for spread into more remote areas that may be vulnerable to invasion, such as grassland habitats in the Bob Marshall Wilderness and other undeveloped areas.

The most abundant invasive species on the forest are oxeye daisy, spotted knapweed, the hawkweed complex, and Canada thistle. The species of highest priority for treatment are Dyer’s woad, tansy ragwort, leafy spurge, both toadflax species, and those species that are on the state noxious list that have not yet found their way onto the forest. Eradication is possible to achieve against some of these species on the forest. Although there are widespread species, such as spotted knapweed and St. John’s wort, which occupy almost all roads, gravel pits, recreation areas and many trails, these species are not considered high priority due to their abundance, both on the forest, in the state, and in the West at large. They are still considered a priority to treat, but with the goal of control, not eradication, as with the aforementioned species. Prioritizing treatment of such widespread weed species around trailheads, and along roads that provide access to them, is a means of preventing spread into wilderness and other undeveloped lands that are currently weed-free. Refer to the Assessment for further details on the current condition of non-native invasive plants species on the forest and future trends.

Non-native invasive plant management

Forest Service policy (specifically Executive Order 13112; FSM 2900) and the national invasive species strategic framework (2013) identify prevention of the introduction and establishment of non-native plant species as an agency objective. This policy directs the Forest Service to:

- Determine the factors that favor establishment and spread of invasive plants
- Analyze invasive species risks in resource management projects
- Design management practices that reduce these risks.

The desired condition inferred from Executive Order 13112, FSM 2900 and the national strategy is the prevention of new infestations (within the area where activities would occur or from the use of travel routes associated with those activities) and to manage the infestations currently established on the forest through control measures.

For all forests, management goals for invaders are to:

- Potential invaders—*prevent* establishment, and if found, promptly *eradicate*
- New invaders—for small infestations, *eradicate*, and for larger infestations, *reduce*
- Widespread invaders—*contain* areas that are already infested and *reduce* plant populations.

Methods used to prevent invasive species from being introduced and spreading into new areas include closing infested areas to travel, washing vehicles and equipment upon entering an area, requiring use of weed-free hay for pack animals, and using weed-free seed and straw mulch for re-vegetation. Treatments such as manual, mechanical, biological, and chemical methods are generally limited to localized areas and those species on the Montana state list. Containment combines prevention and treatment with the objective of limiting spread of an existing infestation and reducing the acres of existing infestations by treating around the perimeter of the infestation. Invasive weed management in cooperation with private and agency partners, county weed districts and others is important in all of these treatment activities.

Seeding of temporary roads as a conservation measure to reduce invasive species infestations has been occurring on National forests for many years. Desirable non-native mixes of grasses and forbs have primarily been used in the past. Native grasses and forbs have been used more in recent years. Observations of some of the temporary roads constructed in the last 30 to 40 years, for example on the Forest, indicate some success in the prevention of infestation in the road corridors (monitoring reports located in Forest invasive plant program records).

Infestations in some sites have been reduced by these measures. However, in spite of these control efforts, existing infestations continue to invade disturbed areas and intact plant communities. It is still common to see noxious weeds along many roadsides, railroad and utility rights-of-way, and other disturbed areas, such as gravel pits. Changes to the landscape with warmer temperatures, associated drier conditions, and more severe or frequent droughts, may lead to more frequent fires and may increase the ability of invasive plants to out-compete native plants in the future.

Below is a description of the management activities or natural processes potentially influencing weed establishment or spread and used as indicators to measure differences in effects among alternatives.

3.6.7 Environmental Consequences

Effects by alternative for management direction

Alternative A – no action

The current forest plan, as amended, is the existing management being used by the Flathead National Forest to address non-native invasive plants. This direction represents the no-action alternative. However, because the no-action alternative is the baseline to which the action alternatives are compared, it is important to understand what actions would continue under the no-action alternative.

The existing Flathead National Forest forest plan includes a forestwide objective for noxious weeds:

- Inventory, map, and complete an activity schedule for five significant noxious weed plant communities during the first planning period (spotted knapweed, dalmation toadflax, leafy Spurge, goatweed, and whitetop) (1986 Plan pg II-8)

and forest-wide standards to:

- Apply herbicides, pesticides and other toxicants in a manner that does not retard or prevent attainment of riparian management objectives and avoids adverse effects on native fish (1986 plan, pg II-34);

Development of additional management direction for noxious weeds has occurred under the existing forest plan. In 1993, Amendment 17 to the forest plan added standards to implement an integrated pest management approach for weeds in the Bob Marshall Wilderness complex, and to prepare an environmental document for use of chemical treatments in this area. This direction is incorporated into the existing forest plan.

In 2001, the Flathead National Forest Noxious and Invasive Weed Control Decision Notice and Finding of No Significant Impact (FONSI) resulted in a more robust integrated pest management program and provided for the use of herbicides with the following active ingredients: clopyralid, dicamba, picloram, 2,4-D amine, and glyphosate.

Since this decision, the chemical industry continues to produce herbicide formulations that improve upon environmental and human safety and/or efficacy and efficiency of weed control. The Flathead National Forest continually evaluates new herbicides to determine if they fall within the parameters of the 2001 decision. For example, metsulfuron sulfur is labeled for the same uses as herbicides in the 2001 decision, is considered low risk to human and environmental safety, moves less through the soil than clopyralid or picloram, has less residual than picloram (therefore low risk of buildup in the soil). Because it is a powder, has less risk of liquid concentrate spill. Metsulfuron sulfur is more effective on houndstongue than any other herbicide in the 2001 decision, and its effective use in a tree improvement area is documented in a letter to the invasive plants program file. Evaluation and use of other new herbicides are also documented in this file, such as chlorsulfuron for dyer's woad on the Tally Lake Ranger District, prometon on the switchyard at Hungry Horse Dam, and aminopyralid in a variety of locations throughout the forest.

Under the no-action alternative there is no targeted amount of acres to treat for noxious weeds. The 2001 Weed Control Decision Notice adopted an adaptive strategy to determine where, when and how to treat sites, considering such factors as weed species and treatment prioritization, ecological importance of the site and funding. In spite of its lack of specificity in the actual 1986 Forest Plan direction, the no action alternative as it is amended encompasses current practices and is considered appropriate to address invasive species while being flexible to budget constraints.

Alternatives B, C and D

A primary difference the action alternatives have compared to the no-action alternative is their targeted management direction, including treatment objectives and more clarity regarding treatment strategies, priorities and methods. Regardless, direction for non-native invasive species is not anticipated to be substantially different with regard to impacts to, or from, vegetation management than the no-action alternative. Management direction under all the action alternatives for non-native invasive plants includes a guideline and treatment objective to obtain desired conditions of invasive species control and maintenance of natural ecological functions. Targeted objectives for non-invasive plant control are an administrative change that promotes measurable objectives and accountability to the program toward reaching desired conditions. The objective was chosen to be responsive toward desirable conditions while also being flexible to uncertain yearly budgets, which is the program's primary operating constraint.

While preference for use of low-leaching chemical treatments is currently exercised under the no-action alternative, the action alternatives formalize this practice. Consideration of technological advances in weed treatments is emphasized, if they are shown equivalent to, or more effective than, existing treatments. Preference is stated regarding the use of low-leaching chemical treatments and application methods to minimize ground and subsurface drift effects. Additionally, the ability to evaluate and incorporate new chemical treatments, if equivalent or more effective than existing treatments, to the integrated pest management program is also current program practice. Thus, the action alternatives update the 1986 Forest Plan by formalizing current invasive species management practices. As such, alternatives B, C and D forest-wide direction is not anticipated to have adverse effects over the no-action alternative.

The action alternatives incorporate standards and guidelines of the Grizzly Bear Conservation Strategy (GBCS), which include a guideline that states "within the NCDE primary conservation area, vegetation and fuels management activities should be restricted in time and space if needed to reduce the potential for adverse grizzly bear disturbance/displacement, as determined by site-specific analysis. *Note*: Management activities such as pre-commercial thinning, burning, weed spraying, and implementation of road best management practices other than instream work may need to be completed during the spring time period in order to meet objectives (especially if needed to prevent resource damage), but should otherwise be restricted in time or space, if needed to reduce the potential for adverse grizzly bear disturbance/displacement."

Often invasive plant species are best treated in spring during emergence, in early summer prior to seed-set, and in fall for new germinants and for susceptible perennial species. Weed treatments rarely if ever can be effectively conducted during the winter denning season, which would be the time when the potential for grizzly bear disturbance would be lowest. Though this GBCS direction may result in some reduction of flexibility in weed treatment implementation, the expectation is that treatments would be able to be timed appropriately to ensure effective weed control, as allowed under the guideline.

Effects by alternative for indicators

Vegetation management

Ground-disturbing activities, equipment transport and use associated with management activities such as timber harvesting, fire treatments and fire suppression, or other authorized uses are a common vector influencing the expansion of noxious weeds and exotic plants. Establishment and expansion of invasive plant infestations is dependent on seed sources in the area or seed transported in from another area and local soil and climate conditions. Most of these risks are minimized with localized site restoration and rehabilitation, as well as use of weed control measures during implementation (e.g., contract clauses to wash equipment).

Lands designated as suitable for timber production are where the vast majority of timber harvest activities and associated road access would be expected to occur. It could be assumed that larger amount of area suitable for timber production may result in more areas where timber harvest could occur to achieve desired vegetation conditions, and thus result in potentially more ground disturbance activities associated with timber harvesting. In actuality, acres harvested is not necessarily directly tied to amount of suitable lands, but also to the treatment type that may be applied in order to achieve the management emphasis associated with the alternative. For example, alternative C has the least amount of land suitable for timber production, but anticipated harvested acres over the next two decades (as modeled) is greater than all other alternatives (refer to table xx). This is because less intensive treatment types (e.g., commercial thinning) that remove less timber volume per acre (i.e., commercial thinning) are used by the model to achieve desired vegetation conditions and desired timber product outputs. For all alternatives, budget is a primary factor as well, constraining harvest levels. Table 27 displays the estimated of harvest acres by alternative over the next two decades, as well as the total acres suitable for timber production. Refer to the Timber section 3.20 and to appendix 2 of this EIS for additional details on determination of the suitable lands and harvest amounts.

Table 26. Total acres suitable for timber production and average annual acres of harvest treatment by alternative, decades 1 and 2 (source: Spectrum model).

	Alternative A Acres	Alternative B Acres	Alternative C Acres	Alternative D Acres
Total acres suited for timber production[a]	526,854	499,066	317,301	500,445
Average annual acres of harvest decades 1 and 2	1,640	2,823	2,907	2,120

[a] As defined by the Planning Rule and described in the Timber section of this EIS.

The acres of harvest are an estimate and actual treatment acres and types would be highly subject to project and site specific conditions, as would potential ground disturbance that may occur from timber harvest activities. The differences between alternatives as to risk of invasive weed establishment and spread disclosed below thus have an element of uncertainty and are likely to be very subtle.

Alternative A

Alternative A has the greatest amount of area suitable for timber production between the alternatives, but the least amount of potential timber harvest. Ground disturbance from timber harvest, and associated vulnerability to invasive weed establishment and spread, may be lowest under this alternative. Management direction to address non-native invasive plant species is in place within the 1986 forest plan, largely via the Flathead National Forest Noxious and Invasive Weed Control Decision Notice and Finding of No Significant Impact, and would continue to be followed.

Alternative B, C and D

Alternative D has the greatest amount of area suitable for timber production between the action alternatives, but the least amount of anticipated harvest acres. Of the action alternatives, alternative D may have the lowest risk of invasive weed establishment and spread associated with timber harvest. Though alternative B and C have substantially different acres suitable for timber production, estimated acres of harvest are similar. Thus these two alternatives may have a similar and higher risk of invasive weed establishment and spread associated with timber harvest compared to alternative D. Management direction to address non-native invasive plant species would continue to be followed, with expectation that weed management would achieve desired conditions related to invasive weeds.

Motorized use and access

A main vector for seed spread is vehicle use (e.g., road construction and maintenance equipment, logging vehicles, and passenger cars and trucks) (Taylor et al, 2012). Many existing infestations can be found along, or have originated from, roadsides because vehicle traffic provides ideal means for noxious weed spread. Roads and vehicle traffic pose difficult challenges to management of invasive species.

Transportation of weed seed by contractor or special use vehicles, or equipment, on NFS roads is managed to a degree. Contract stipulations are used to require specific actions, e.g., vehicle and equipment washing, to lessen the possibility of weed transport to reduce the risk of new infestations. Use of roads and motorized trails by the general public presents a greater risk, because of the lack of control measures and the lack of knowledge about invasive species spread.

Alternatives vary in the amount of motorized access opportunities for recreational use, both on roads and trails. These differences are tied primarily to differences in forest plan direction for grizzly bear habitat management and in management area designations. Summer motorized uses pose the greatest risk of invasive weed transport. The amount of the forest in recreational opportunity spectrum (ROS) classes that allow for summer motorized recreational uses also provides an indication of the potential area where risk of weed establishment and spread may be higher. Table 28 displays the amount of forest by alternative with summer motorized recreation opportunity spectrum classes. Refer to Recreation and Access and the Infrastructure section of this EIS for more detailed discussion.

Table 27. Estimated percent of the forest in desired summer motorized and roaded natural recreational opportunity spectrum classes by alternative.

Category	Alternative A	Alternative B	Alternative C	Alternative D
% of area in summer semi-primitive motorized ROS class	3%	3%	1%	8%
% of area in roaded natural ROS class	25%	28%	24%	34%

Because of the small differences and site specific localized nature of weed infestation and spread, changes in weed spread or establishment estimated at the programmatic level would be subtle and may not be noticeable on the ground or attributable solely to actions associated with different road density or summer motorized access. A site-specific environmental evaluation would be required prior to on-the-ground activities to determine specific impacts, and integrated weed management and re-vegetation of disturbed sites would continue to be used to treat infestations. Ccontinuing public education efforts about invasive species prevention would also be a consideration.

Alternative A

Alternative A would provide the least opportunity for wheeled motor vehicle use (allowed on designated roads) on 913 miles of the Forest. In addition, approximately 57 miles of wheeled motorized trails would need to be closed under alternative A to provide grizzly bear security core (refer to section 3.9 and 3.11 for details on road management changes). The existing lands allocated to summer semi-primitive motorized or roaded natural recreational opportunity spectrum classes is a total of 28% of the forest, which when compared with the desired ROS in the action alternatives is second lowest of all alternatives.

Alternative A would result in the greatest long-term overall decrease in motorized roads and trails, as well as the second lowest amount of area with summer motorized recreational opportunity. The potential for invasive species establishment and spread due to ground disturbance and impacts from motorized uses is likely lowest under alternative A. Inadvertent seed spread could decrease in areas that are either closed to motorized access or are more difficult to access. However, during road closure/decommissioning activities that require short-term ground disturbance (e.g., relocating gates), there could be short-term invasive plant establishment until invasive weed treatments are applied to the disturbed area. Additionally, road closures and/or decommissioning make administrative access more difficult to treat invasive species in some areas of the forest.

Alternative B, C and D

Alternatives B and D would provide the opportunity for wheeled motor vehicle use (allowed on designated roads) on 1,431 miles of the Forest, the most of all alternatives. Alternative C has opportunity for wheeled motor vehicle use (allowed on designated roads) on 1,356 miles of the Forest, more than alternative A but less than alternatives B and D. Refer to section 3.9 (Recreation and Access) and 3.11 (Infrastructure) for details on road management changes.

Alternatives B and D have little changes in existing amounts of motorized roads and trails, and thus would result in no change from existing invasive plant conditions associated with these uses. However, alternative C would result in an overall long-term decrease in motorized roads and trails, with associated reductions in ground disturbance and potential for invasive species establishment and spread. In alternative C, inadvertent seed spread could decrease in these areas that are either closed to motorized access or are more difficult to access. During road closure/decommissioning activities that require short-term ground disturbance (e.g., relocating gates), there could be short-term invasive plant establishment until invasive weed treatments are applied to the disturbed area. Additionally, road closures and/or decommissioning make administrative access more difficult to treat invasive species in some areas of the forest.

The desired amount of lands allocated to summer semi-primitive motorized or roaded natural recreational opportunity spectrum classes is a high of 42% under alternative D, followed by 31% under alternative B and the lowest amount of 25% under alternative C. These ROS classifications define areas with opportunities and suitability for motorized vehicle uses. Increased area classified as a motorized summer ROS could imply a potential increase in motorized use within the area in the future. However, there are many forest plan components that restrict motorized use across the forest, particularly those associated with grizzly bear habitat management. A site-specific environmental evaluation would be required prior to authorizing any new motorized uses, and notable increases in motorized use across the forest is not expected to occur under any alternative. In any case, integrated invasive plant management would continue to occur under all alternatives to manage and control weed infestations.

Recreation

Recreational activities, including non-motorized, are another vector for potential seed establishment and dispersal. Recreation activities and areas receive concentrated and frequent use and continual ground disturbance. Generally, wilderness areas and large unroaded lands are less likely to contain invasive weeds due to less widespread public access, especially via motorized means. However, these large unroaded areas are vulnerable to weed infestation and spread from recreational uses. Seed transport happens inadvertently, by humans, dogs, and pack stock. Trails that receive high uses, including those in wilderness areas, are vulnerable to invasive weed infestation, and may serve as vectors for spread into surrounding sites. Bike and horse trails, and motorized trails are at higher risk of introduction, spread and establishment of weeds compared to hiking trails. Areas of high use and ground disturbance occur within wilderness areas and are as vulnerable to weed infestation as developed sites outside wilderness. Frequently, infestations are found around trailheads, trails, campgrounds, and other developed recreation sites. These seed sources pose a risk of further spread into wilderness and undeveloped lands. Areas located immediately adjacent to and surrounding developments tend to experience the most disturbance, while the peripheries of these areas are less disturbed and less likely to be favorable for invasive species establishment and persistence.

Motorized and mechanized recreation vehicles are another common vector of seed transport and establishment primarily because there is minimal control over allowing weed-infested passenger and recreation vehicles to travel Forest roads and trails. See discussion under Motorized use and access above.

Methods used to help prevent invasive species from being introduced and spreading into recreation areas include public education and requirements for use of weed-free hay for pack stock, in addition to weed control methods used by the Forest, contractors and volunteer groups.

Alternative A

Under the no-action alternative, there is less limitation on the number of developed recreation sites that could be constructed as there is under alternatives B, C and D (see Recreation and Access section of this EIS). As such, there could be more potential for ground disturbance under the no-action alternative, and the potential for invasive species establish and spread could be greater, than under the action alternatives. However, this may not be a significant difference or a noticeable increase, particularly when site-specific factors are considered, let alone attributable solely to activities related to recreation developments. Treatments would continue as would prevention efforts. However, for comparison of alternatives qualitatively, the lack of a limitation for the number of recreation developments is a distinctive feature of the no-action alternative for the Flathead National Forest.

Management direction to address non-native invasive plant species is already in place and has been followed where these plants are known to occur, or potential habitat is suspected to exist. Continuation of current invasive plant species management, including the methods approved via the Flathead National Forest Noxious and Invasive Weed Control Decision Notice, would still be available to treat infestations related to use of recreation sites.

Alternative B, C, and D

Under the action alternatives, there is more limitation on the number of recreation developments that could be constructed than under the no-action alternative. As such, there could be less ground disturbance under the action alternatives, and the potential for invasive species to establish and spread could be less than under the no-action alternative. However, this may not be a significant or noticeable difference particularly when site-specific factors are considered, let alone attributable solely to activities related to recreation developments. Treatments would continue as would prevention efforts. However, for comparison of alternatives qualitatively, a limitation for the number of recreation developments is a distinctive feature of alternatives B, C and C related to invasive species treatments.

Livestock grazing

Invasive species expansion may also occur with the transport of seed by livestock from infested areas. However, there is not much grazing in the Flathead National Forest (refer to Grazing section of this DEIS). Although there is not much rangeland on the Forest, the areas that support livestock have been impacted by infestations.

Seeds can be spread through livestock feces, fleeces, and hooves (Belsky and Gelbard 2000), and many can pass through an animal’s digestive system and retain the ability to germinate (Belsky and Gelbard 2000). Native grazers such as mule deer, bighorn sheep and elk, and some birds such as mourning doves, can also perform this same method of seed spread. Conversely, domestic livestock grazing (in a process known as prescribed grazing) has also been shown to be an effective method in managing some large invasive plant infestations while assisting the ecological succession process (Jacobs 2007).

Localized areas where excessive grazing duration and use contributes to reduced ground cover can become potentially susceptible to invasive plant establishment, and areas with low plant cover and frequent disturbance are most at risk to invasion. These areas on the Flathead National Forest are generally roadsides, stream banks and areas where stock congregate, such as salt blocks.

Alternatives A, B, C and D

There is relatively small area on the forest subject to livestock grazing, and no change in the existing forest conditions or existing forest plan direction relative to grazing would occur under the action alternatives. Livestock grazing poses a relatively small risk of invasive weed establishment and spread on the Forest.

Fire

Fire, though a natural and desired ecological process, can have a detrimental impact to the ecosystem post-fire, depending on the occurrence of invasive species infestations pre-fire. Fire can result in an increase in non-native species diversity and cover, whether it is a prescribed burn or a wildfire (Zouhar et al. 2008). While invasive species such as cheatgrass may alter fire regimes in drier forests, shrublands and grasslands, there is no evidence that the presence of invasive plants in moister forested landscapes changes fire regimes (Keeley and McGinnis 2007). There is little published data on the relationship between fire and invasive plant species in the moist montane forests typical of the Flathead Forest (USDA 2008). Since most invasive plant species are shade intolerant, reduced light availability as the forest grows and the canopy closes may reduce invasive species over time.

Alternatives A, B, C and D

Wildfires would occur in the future under all alternatives, and though uncertainty exists as to extent and location, they would be similar under all alternatives, and influenced largely by weather and climatic factors. Generally, prescribed fire implementation would be similar under all alternatives as well. There is potential for establishment and spread of invasive plant species within burned areas, depending largely upon site specific conditions, such as fire location and forest types that were burned, presence of weed infestations pre-fire, potential vectors, and fire characteristics. Weed infestations within burned areas would be addressed following forest plan management direction, which is similar and in place for all alternatives.

Consequences to non-native invasive plants from forest plan components associated with other resource programs or revision topics

Effects from fire and fuels management and vegetation management activities

Undesirable effects from other resource programs would be limited to ground disturbance resulting from management activities that leads to introduction, spread, establishment and persistence of invasive species, as discussed above under indirect effects. Site-specific projects are evaluated under the National Environmental Policy Act for this impact and generally projects have requirements to address invasive species during project implementation to prevent it.

For fire treatments, wildfire, and planned ignitions that escape controls, invasive species introduction, spread, establishment and persistence has a potential for occurrence. These circumstances result in a change of treatment priorities for the invasive species management program, under both the action and the no-action alternatives.

Vegetation management activities such as timber harvest, the use of skidders and mechanical harvest techniques and equipment have contributed to the introduction, spread, establishment and persistence on the landscape. Harvest prescriptions provide a range of soil disturbance and canopy removal which provide suitable conditions for weeds to infest forested areas. The movement of equipment and the use of skid trails provide vectors for weed propagules to move from timber unit to timber unit. Contract specifications help prevent introduction of weed seed to units from outside Forest Service lands by requiring cleaning of equipment. Other weed BMPs include pre- and post-implementation spraying of haul routes, as well as seeding disturbed areas after implementation to prevent establishment of infestations.

Effects from road management program

Road maintenance, reconstruction and construction can contribute to the establishment and spread of invasive plants. Gravel pits often are infested with weeds. Weed seeds can be spread onto lands far from the gravel pit when gravel is used for road surfacing or other purposes. This effect would be the same under all alternatives. Management direction to address invasive plant species is in place for all alternatives and would continue to be followed. Gravel pits would be a priority area to consider for weed management and treatments.

Cumulative Effects

The effects that past activities have had on non-native invasive plants were discussed in the "Affected Environment" section and are reflected in the current condition. Therefore, past activities are not carried forward into the cumulative effects analysis. Consequences to non-native invasive plants from forest plan components associated with other resource programs or revision topics is a form of cumulative effects analysis and was discussed in the previous section. Cumulative effects associated with implementation of the grizzly bear conservation strategy are discussed in volume 3 of the environmental impact statement.

Invasive species spread without regard to administrative boundaries. As such, the cumulative effects of the Flathead's treatment of weeds under any alternative, including the no-action alternative, may negatively or beneficially impact adjacent federal, state and private lands depending upon the specific site treatment or lack thereof. Adjacent or nearby landowners specific site conditions and weed treatment efforts also would affect weed conditions and treatments on Forest lands. Over 800,000 acres of non-Flathead National Forest lands (mostly private) lie within the boundaries of the geographic areas of the Forest, though most do not occur directly adjacent to Forest lands. Under all of the alternatives, coordination with state and local agencies and communication with the public would continue under all alternatives to combat the spread of undesirable, non-native invasive species.

Climate change

Climate change is likely to result in differing responses among invasive plant species, due to differences in their ecological and life history characteristics. As documented in the Northern Rockies Adaptation Partnership Vulnerability Assessment (2015), climate change could result in either range expansion or contraction of an invasive species. For example, modeling indicates that leafy spurge is likely to contract and spotted knapweed is likely to shift in range. Invasive species are generally adaptable, capable of relatively rapid genetic change, and many have life history strategies (e.g., prolific seed production, extensive deep roots) which can enhance their ability to invade new areas in response to changes in ecosystem conditions. Warmer temperatures, and associated drier conditions, more severe or frequent droughts, and more favorable conditions for wildland fire may increase the ability of invasive plants to establish and out-compete native plants. These changes may provide more opportunities for invasive plants to gain an advantage over native species, and spread beyond the Flathead's boundaries. This potential effect is common to all alternatives.

Summary of Effects to Invasive Plants

Alternatives B, C and D for non-native invasive plants updates the 1986 Forest Plan by formalizing current, effective invasive species management practices. These practices are administrative in nature and result in no adverse effects to the invasive species management program. Potential for invasive weed establishment and spread associated with motorized uses and ground-disturbing timber harvest activities differ between alternatives, with alternative C overall having the least potential, due to the reduced area suitable for timber production, the lowest proportion of the forest in summer motorized recreational opportunity spectrum classes, and the reduction of motorized roads and trails over time. Alternatives A, B and D are more similar in their potential for weed infestation, though the substantial amount of motorized roads and trails reduced under alternative A as compared to no reduction in alternative B and D likely is more favorable to limiting weed infestations.

Consequences to non-native invasive plants from forest plan components associated with other resource programs or revision topics are similar under both the no-action and action alternatives. Suggested timing restrictions for treatments are more restrictive for alternatives B, C and D. However, invasive species may be treated outside of the suggested restrictions to be effective on the landscape and to meet desired conditions for vegetation and forest resilience.

3.7 Wildlife

3.7.1 Introduction

In 2005, a cooperative study was completed that looked at the relationship between fish and wildlife conservation and economic prosperity in Montana (MFWP 2005). This study (sponsored by Montana Fish, Wildlife & Parks and the U.S. Forest Service Northern Region) highlighted the importance of wildlife-related activities to residents of Montana, as well as those visiting the state. The percent of Montana's population participating in wildlife-related activities (hunting, fishing, wildlife viewing, and bird watching) was substantially higher than for the nation or for the Rocky Mountain Region of the west. Similarly, the most recent National Visitor Use Monitoring survey done on the Forest indicated that 36% of visitors participated in wildlife viewing and 18% participated in hunting (see Recreation section of DEIS chapter 3 for more details).

The wildlife sections of the DEIS address consequences of implementing alternative A, the 1986 forest plan (as amended), compared to 3 alternatives. The 2012 planning rule has requirements that the forest plan must include plan components designed to maintain, restore, or promote ecosystem diversity, key ecosystem characteristics, and habitat types (USDA 2012, 219.9(a)(2)). The diversity of terrestrial, riparian, and aquatic ecosystems and habitats is fundamental to providing ecological conditions that support the abundance, distribution, and long-term persistence of native species. Ecosystems and their composition, structure, dominant processes, and connectivity are addressed in the Flathead National Forest Assessment (April 2014), the forest plan, the DEIS, and in the planning record set of documents. A list of species known to occur on the Flathead National Forest and their association with ecosystems and key ecosystem characteristics can be found in appendix D of the forest plan.

The 2012 planning rule requires that "plans use a complementary ecosystem and species-specific approach to provide for the diversity of plant and animal communities and to maintain the persistence of native species in the plan area. Ecosystem plan components would be required for ecosystem integrity and diversity, along with additional, species-specific plan components where necessary to provide the ecological conditions to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain viable populations of "species of conservation concern". (USDA 2012 Federal Register /Vol. 77, No. 68 /Monday, April 9, 2012 /Rules and Regulations pg. 21169).

During the planning process, ecosystem/key ecosystem characteristics were evaluated and determinations made on whether associated wildlife species needs would be met by emerging plan components, considering known locations of species and their habitats, as well as key drivers/stressors. Additional species-specific plan components were then considered.

Federally Recognized Wildlife Species

Federally recognized species are those that have threatened, endangered, proposed, or candidate status under the Endangered Species Act (table 30). The Flathead National Forest does not have any proposed or candidate wildlife species as of 4/20/ 2016 (www.fws.gov/montanafieldoffice/Endangered_Species/Listed_Species/Forests/Flathead_sp_list.pdf). The action alternatives (B, C, and D) have coarse filter as well as fine filter plan components for these species.

Wildlife species currently listed for the Forest include the grizzly bear and Canada lynx. The Forest contains designated critical habitat for one federally listed wildlife species, the Canada lynx. Consequences of alternatives for the grizzly bear, Canada lynx, and Canada lynx critical habitat are addressed in Chapter 3 below. Three additional species (bald eagle, peregrine falcon, and gray wolf) were listed as federally threatened or endangered when the 1986 forest plan (Alternative A) was developed but have since recovered and been de-listed. These species are included in the wildlife analysis because the public expressed an interest in them during scoping.

Table 30. Federally recognized wildlife species on the Flathead National Forest

Species Common Name	Species Scientific Name	Status
Grizzly Bear	*Ursus arctos horribilis*	Threatened and expected to be proposed for delisting by the USFWS because populations have met recovery objectives.
Canada lynx	*Lynx canadensis*	Threatened; critical habitat designated

Because this DEIS is also evaluating the effects of alternatives for four other national forests in the Northern Continental Divide Ecosystem with respect to plan components for the grizzly bear, cumulative consequences to the grizzly bear are addressed in Chapter 6, along with indirect effects for the four forests.

Wildlife species listed as species of conservation concern by the regional forester

A species of conservation concern (SCC) is a species, other than federally recognized threatened, endangered, proposed, or candidate species, that is known to occur in the plan area and for which the regional forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long-term in the plan area (36 CFR 219.9)(USDA 2012, Federal Register /Vol. 77, No. 68 /Monday, April 9, 2012 /Rules and Regulations pg. 21169)(see table 31). More information about the Region 1 SCC can be found at: www.fs.usda.gov/goto/flathead/SCC.

Table 28. Species of conservation concern (SCC) on the Forest and their associated biophysical settings/key ecosystem characteristics

Common Name	Scientific Name	Section Containing Analysis
Black swift	*Cypseloides niger*	Wildlife Diversity - aquatic, wetland, and riparian habitats
Clark’s nutcracker	*Nucifrage columbiana*	Wildlife Diversity - coniferous forest habitats
Fisher	*Pekania [formerly Martes] pennanti*	Wildlife Diversity - old growth habitat and very large live and dead trees
Flammulated owl	*Otus flammeolus*	Wildlife Diversity – coniferous forest habitats
Harlequin duck	*Histrionicus histrionicus*	Wildlife Diversity - aquatic, wetland, and riparian habitats; cold, fast-moving rivers and streams
Townsend’s bog-eared bat	*Corynorhinus townsendii*	Wildlife Diversity - rock, cliff and cave habitats

Other key species of interest in the analysis

The species in this section (table 30) are analyzed as examples of wildlife diversity. The public; Montana Fish, Wildlife and Parks (MFWP); and members of the Confederated Salish and Kootenai Tribes (CSKT) participated in the planning process and expressed a high level of interest in them during scoping. The species listed in table 30 are not federally recognized by the USFWS and are not listed as species of conservation concern by the regional forester. Species that are recently de-listed or previously identified as sensitive species are included in table 30, as are key species of interest for observing, hunting, trapping, or subsistence (see appendix D for more details). The analysis discusses how their needs are expected to be provided for by plan components for a variety of ecosystems/key ecosystem characteristics. In addition, some of the species (e.g. those that are sensitive to certain types of human disturbance) may have species-specific plan components in one or more alternatives, as discussed in the species sections. Species used as examples are addressed in the section of the analysis most relevant to their key ecosystem or ecosystem characteristics.

Table 29. Key wildlife species of public interest

Species Common Name	Species Scientific Name	Section Containing Analysis
Bald eagle Beaver Boreal [Western] toad Common loon Northern bog lemming	*Haliaeetus leucocephalus* *Castor Canadensis* *Bufo boreas* *Gavia immer* Synaptomys *borealis*	Wildlife Diversity - aquatic, wetland, and riparian habitats
Wolverine	*Gulo gulo luscus*	Wildlife Diversity - high elevation habitats; persistent spring snow
Mountain goat Peregrine falcon	*Oreamnos americanus* *Falco peregrinus*	Wildlife Diversity - cliff, cave and rock habitat
Elk Gray wolf Marten Moose Mule deer Northern goshawk White-tailed deer	*Cervus Canadensis* *Canis Lupus* *Martes Americana* *Alces americanus* *Odocoileus hemionus* *Accipiter gentilis* *Odocoileus virginianus*	Wildlife Diversity - coniferous forest habitats in a variety of successional stages
Pileated woodpecker	*Drycopus pileatus*	Wildlife Diversity - old growth habitat, very large live and dead trees
Black-backed woodpecker Olive-sided flycatcher	*Picoides arcticus* *Contopus cooperi*	Wildlife Diversity – wildlife associated with burned forests and dead trees and dead trees less than 20 inches dbh

3.7.2 Legal and Administrative Framework

The following is a key set of statutory authorities that affect wildlife management on NFS lands. They are briefly identified/described below to provide context to the management and DEIS evaluation of the wildlife resource. There are multiple other laws, regulations and policies not described below that also guide the management of this resource (see DEIS chapter 3).

Law and executive orders

The Hellgate Treaty of 1855: The Confederated Salish and Kootenai Tribes of Montana, which includes the Kootenai, the Bitterroot Salish, and the Pend d'Oreille Salish peoples, have reserved treaty rights in the plan area under the Hellgate Treaty of 1855. These treaty rights include hunting, gathering, and grazing rights on Federal lands within the plan area.

The Migratory Bird Treaty Act of 1918: Prohibits unauthorized take of migratory birds, as defined through subsequent regulations. Executive Order #13186 (Federal Register, Vol. 66, No. 11, 2001) outlines responsibilities of federal agencies to protect migratory birds in furtherance of the purposes of the Migratory Bird Treaty Act.

The Bald and Golden Eagle Protection Act: Prohibits unauthorized take of bald and golden eagles, as defined through subsequent regulations.

Sikes Act of 1960: Forest Service policies recognize that state agencies and Indian tribes are responsible for the management of animals and assign national forests a role in cooperatively managing wildlife habitat.

The Endangered Species Act of 1973, as amended: Provides requirements for federal agencies with regard to species listed under the act.

The National Forest Management Act (NFMA) of 1976: The NFMA states that the Secretary shall "promulgate regulations," under the principles of the Multiple-Use Sustained-Yield Act of 1960, to "provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives, and within the multiple-use objectives of a land management plan adopted pursuant to this section, provide, where appropriate to the degree practicable, for steps to be taken to preserve the diversity of tree species similar to that existing in the region controlled by the Plan" (Public Law 94-588, Sec. 5 (g)(3)(B)). The 2012 planning rule was determined to be consistent with this act (USDA 2012, Vol. 77, No. 68 / Monday, April 9, 2012 / Rules and Regulations pg. 21162).

Other regulation, policy, and guidance

The 2012 planning rule: Relative to wildlife species, the rule directs the Forest to consider: 1) habitat conditions, subject to the requirements of § 219.9, for at risk species, 2) habitat conditions, subject to the requirements of § 219.9, for wildlife, fish, and plants commonly enjoyed and used by the public for hunting, fishing, trapping, gathering, observing, subsistence, and other activities in collaboration with federally recognized Tribes, Alaska Native Corporations, other Federal agencies, and State and local governments (USDA 2012, § 219.10 (a)(5)); 3) dominant ecological processes, disturbance regimes, and stressors such as natural succession, wildland fire, invasive species, and climate change; 4) the ability of the terrestrial and aquatic ecosystems on the plan area to adapt to change (USDA 2012, § 219.8)); and 5) habitat/habitat connectivity, and 6) riparian areas, (USDA 2012, § 219.10 (a)(1)) (also see Terrestrial Vegetation section).

The Travel Management Rule: provides general criteria for designation of National Forest System roads, National Forest System trails, and areas on National Forest System lands. In designating National Forest System roads, National Forest System trails, and areas on National Forest System lands for motor vehicle use, the responsible official shall consider effects on National Forest System natural and cultural resources, public safety, provision of recreational opportunities, access needs, conflicts among uses of National Forest System lands, the need for maintenance and administration of roads, trails, and areas that would arise if the uses under consideration are designated; and the availability of resources for that maintenance and administration. Subpart (b) provides specific criteria for designation of trails and areas. In addition to the criteria in paragraph (a) of this section, in designating National Forest System trails and areas on National Forest System lands, the responsible official shall consider effects on the following, with the objective of minimizing: (1) Damage to soil, watershed, vegetation, and other forest resources; (2) Harassment of wildlife and significant disruption of wildlife habitats (Federal Register /Vol. 70, No. 216 /Wednesday, November 9, 2005 /Rules and Regulations).

3.7.3 Methodology and analysis process

To evaluate ecological sustainability, the planning team identified key ecosystems/ecosystem characteristics and indicators for Vegetation, Soil, Aquatic, and Riparian Ecosystems (see these sections of DEIS chapter 3 for more details).

The Flathead began working with the regional office on the process of evaluating potential species of conservation concern and sought comments from the public and other agencies prior to publication of its assessment, using the draft planning rule directives. This process continued through development of the revised plan and DEIS. The process involved the following steps:

- The Flathead planning team biologist requested a list of species from Montana Natural Heritage Program, as well as GIS locations and associated data (e.g. global and state rank; consideration of listing as a proposed or candidate species or state species of concern; whether native or accidental), and determined those species known to occur within the plan area (see Assessment Appendix D and planning record exhibits V-1 and V-2).
- The planning team biologist worked with scientific experts including local biologists from the U.S. Forest Service; Montana Fish, Wildlife and Parks; Glacier National Park; the Confederated Salish and Kootenai Tribes; and local birding groups to gather scientific information on species and to refine species associations with particular ecosystems, key ecosystem characteristics, or ecosystem conditions (see Assessment Appendix D). Many of the individuals consulted have several decades of accumulated expertise on species and habitats of northwest Montana, including all lands (see § 219.9(b)(2)(ii)).
- The planning team biologist reviewed species lists and status for adjacent national forests (Kootenai, Lolo, Lewis & Clark/Helena); coordinated with neighboring national forests and the regional ecologist (USDA 2012 Federal Register /Vol. 77, No. 68 /Monday, April 9, 2012 /Rules and Regulations pg. 21175).

After the publication of the Forest's assessment, the final planning rule directives were issued, and the Forest continued seeking information on local wildlife populations and habitat factors including abundance, distribution, stressors, trends in habitat, and responses to management..

The wildlife analysis process includes:

- Assessment of key ecosystem characteristics (USDA 2015 FSH 1909.12 sec. 12.13) including habitat connectivity,
- Assessment of possible system drivers and stressors (USDA 2015 36 CFR 219.6(b)(3)) and their influences on key ecosystem characteristics,
- Assessment of the natural range of variation for selected key ecosystem characteristics (or a suitable alternative) to establish a context for whether ecosystems are functioning properly (USDA 2015 FSH 1909.12 sec. 12.14a and 12.14b),
- Assessment of the status of the ecosystem based on projected trends of key ecosystem characteristics after considering the current plan and influence of climate changes (USDA 2015 FSH 1909.12 (sec. 12.14c).

As stated in the 2012 planning rule directives, key ecosystem characteristics may be added or modified during the planning phase (USDA 2015 FSH 1909.12 sec. 12.13). Examples of key ecosystem characteristics for composition, structure, function, and connectivity are identified in the final directives for the 2012 Planning Rule (USDA 2015 FSH 1909.12, chapter 10, 12.13 exhibit 01). Many of the key ecosystem characteristics contribute to biodiversity and are important to wildlife for nesting, denning, feeding, movement within home ranges, and/or movement between home ranges, as discussed throughout the wildlife section of this DEIS. For details on key ecosystem characteristics and how they are associated with wildlife species of the Forest, see the" affected environment" sections of the DEIS and revised forest plan appendix D. For possible management approaches see appendix C.

Drivers/stressors and their influence on key ecosystem characteristics are also discussed in the Flathead's Assessment and throughout this DEIS. For details on methods used to assess the natural or historic range of variability, as well as projected trends, see the Forest's assessment appendix B, revised forest plan appendix D, and DEIS appendices 2 and 3.

During the planning process, ecosystems/key ecosystem characteristic were evaluated and determinations made on whether associated wildlife species needs were met by emerging plan components, considering known locations of species and their habitats, as well as key drivers/stressors. Additional species-specific plan components were then considered. The alternatives are built on the principle that by restoring and maintaining the key characteristics, conditions, and functionality of native ecological systems and managing for additional needs of key species, the forest will be able to:

- maintain and improve ecosystem diversity,
- provide for the habitat needs of diverse plant and animal species on the forest,
- support persistence of native species,
- support social and economic benefits derived from observing, hunting, and trapping wildlife.

Organization of the wildlife analysis

The wildlife diversity analysis is organized by key ecosystems/ecosystem characteristics that provide habitat for associated wildlife species. Each individual section of the wildlife analysis begins with a section on coarse filter plan components and effects to most species, followed by sections on specific species, as applicable. The Forest's species currently designated as threatened species by the USFWS, including the grizzly bear, Canada lynx, and Canada lynx critical habitat are discussed separately in the section on "Threatened and Endangered Wildlife Species".

Within the species sections of this document, information on species life history and habitat provides the context for plan components, the capability of lands on the Forest, and key indicators of consequences of alternatives. The affected environment, habitat section, describes key ecosystem characteristics associated with a species. The planning team biologist considered the many stressors that may affect species and their habitats on and off the plan area and determined key stressors that are most relevant to the Flathead National Forest. The key stressors section provides a foundation for the alternative effects analysis and an understanding of which stressors the USFS has authority to manage. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are sactivities that might impact a species and its habitat if not managed or mitigated. Stressors that are outside of Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. These are considered under "Cumulative Consequences".

The analysis of consequences looks at the plan components in the alternatives in the form of objectives, desired conditions, suitability, standards, and guidelines which may be associated with a management area (MA), geographic area (GA), forestwide, or associated with identified subsets of the forest (e.g. biophysical settings or grizzly bear management zones) . The wildlife analysis does not analyze plan components if they are not relevant to the key stressors or have some effect for a species or its key ecosystem characteristics.

Spatial and temporal analysis

In general, the analysis area for indirect effects to most wildlife species is NFS lands within the Flathead National (see figure 1). The cumulative effects analysis area for most species is also the Forest, but includes all lands. Because the grizzly bear, gray wolf, and wolverine are particularly wide-ranging species, the cumulative effects analysis area is the area identified as the Northern Continental Divide Ecosystem (see figure B-01). The cumulative analysis area for Canada lynx is the area delineated by Squires and others (2013), encompassing portions of the Kootenai and Forests, the Seeley Lake and Lincoln Ranger districts on the Lolo and Helena NFs, as well as Glacier National Park. Squires stated that this area encompassed the occupied range of lynx in the northern Rocky Mountains, based upon a compilation of telemetry data from 1998-2007. This area also encompasses telemetry locations of lynx captured on the Forest from 2009-2015. Areas selected for analysis of cumulative effects are large enough to include consequences of activities on all lands, but not so large as to obscure effects.

The anticipated life of the Plan is about 15 years. However, because management actions have the potential to affect wildlife species and their habitats for many decades, the temporal analysis for modelled vegetation change and cumulative effects will discuss changes that may occur over the next 50 years, as conditions change and vegetation moves from one successional stage to another. Climate change is included in the affected environment/key stressors section of the analysis because it is on-going and is part of the baseline condition. The analysis of consequences of alternatives also considers anticipated effects of climate changes in the future.

Incomplete and unavailable information

A thorough review of scientific information was completed and the best available scientific information was used to inform the planning process and develop plan components. Some information for wildlife habitats and populations is incomplete or unavailable and if local information is not available, information from neighboring areas with similar species and/or habitats may have been used. While we recognize there are data and information gaps, the breadth and depth of available scientific information is sufficient to determine key stressors and plan components needed to address key stressors.

There may be uncertainty regarding population trend or the causes of wildlife population changes. For example, population surveys of bats are difficult to conduct because of the difficulty in finding and accessing many caves, the nocturnal behavior of bats, their large home ranges, and difficulty of species identification. Modeling landscape features used by bats offers an alternative approach to multi-species population monitoring, however, a large base of distribution records that sample all species and account for all activities (foraging, roosting, rearing young, mating, hibernating) is often not available (Hendricks and Maxell 2005).

Due to the natural range of variability in the northern Rocky Mountains, fluctuations in wildlife populations and their distribution are normal. They may occur due to changes in habitat, but fluctuations may occur even when there has not been a noticeable change in habitat. These fluctuations may be due to factors such as competition, disease, hunter or trapper harvest, effects of climate changes, and other factors. In addition, for migratory species, a change in population may not represent a change in local habitat conditions. Many species found on the Forest migrate and are influenced by activities or conditions that occur elsewhere in the U.S. or even in other countries. For example, there are 71 species of neo-tropical migratory birds on the Forest (see planning record exhibit V-3). While we can assess effects of alternatives on the key ecosystems/ecosystem characteristics they are associated with during the breeding season, activities or conditions where they winter may not be known, and may affect our ability to draw conclusions about population trends or cause and effect relationships.

While the Forest Service has extensive tools to estimate habitat that supports wildlife species, the full extent of species distribution or risks to their long-term persistence on the Forest, may not be well understood or known or may be the subject of scientific disagreement. Current technology, budgets, and the remoteness of much of the Forest limit our ability to accurately detect or map all key ecosystem characteristics at a forestside scale. For example, FIA datasets are statistically accurate, but were not intended to provide spatial information. As a result, FIA data can be used to estimate the amount of old growth at a forestwide scale, but field inventories are necessary to accurately determine the location of old growth, its patch size, its connectivity, and other characteristics associated with its quality (see Vegetation section of DEIS chapter 3 for more details). VMAP datasets provide remotely-sensed spatial information on vegetation, but the Forest's VMAP data base does not provide characteristics such as snag density or the density of shrubs and small trees in the understory that are important to some wildlife species. The available data is sufficient for programmatic planning and analysis. More detailed information is gathered during field inventories conducted for implementation of projects.

Use of models, maps, and data

The Forest relied on a variety of databases (e.g. those from state agencies, Rocky Mountain Research Station, its own internal databases), to support the development of plan components and assess consequences of alternatives to wildlife. The Forest's map-based information is stored in a geographic information system (GIS) database maintained by the Forest's GIS specialists.

Downscaled climate models are used to predict effects of a changing climate. For this DEIS, we used a compilation of climate change effects published for the Northern Region Adaptation Partnership (NRAP 2015) which summarizes climate change projections by sub-regions (for more details see DEIS Chapter 3; section on relationship of revised forest plan and future climate).

There are multiple connectivity models for multiple species, using a variety of methods, including circuit theory, resistance surface, least-cost pathway, and expert opinion models, to name a few. As stated by McClure and others, "additional comparative tests are needed to better understand how relative model performance may vary across species, movement processes, and landscapes, and what this means for effective connectivity conservation" (McClure et. al. 2016). The Forest considered the best available models to assess wildlife connectivity.

Models were used to assess key ecosystems, ecosystem characteristics, and their natural range of variability (NRV). NRV has been modeled at large scales, such as the Columbia River Basin (see Assessment of the Flathead National Forest, April 2014) to smaller scales. For the Forest's plan revision, NRV for vegetation composition, size class, canopy cover, density, pattern, patch size, and patch distribution were modelled for vegetation (see Vegetation section of DEIS Chapter 3, DEIS appendix 2, revised plan appendix D).

NRV reflects the ecosystem conditions that have sustained the current complement of wildlife and plant species on the Forest, and provides context for understanding the natural diversity of ecosystems and processes, such as wildfire, insects & disease, and plant succession. The natural range of variability, current condition, and future trends for vegetation were estimated using the SIMPPLE and Spectrum models, using VMAP and FIA datasets for inputs and calibration of the models. Model outputs show future trends over the next 50 years, but there is uncertainty regarding the timing and magnitude of trends due to uncertainty associated with models. Out of necessity, the models simplify a very complex and dynamic relationship between ecosystem processes and vegetation over time and space (see Vegetation section of DEIS Chapter 3 for more details). Ecosystem Research Group interpreted vegetation model outputs to estimate NRV, current, and potential future habitat for a select set of wildlife species over the next 50 years (see DEIS Appendix 3 for more details). Ecosystem Research Group also interpreted vegetation model outputs to estimate connectivity of cover for wildlife in key connectivity areas over the next 50 years (see DEIS Appendix 3 for more details).

There is uncertainty with all models, including models of the natural range of variability that occurred in the past, as well as the changes predicted to occur in the future. In addition, models, maps of habitat, and numeric estimates of habitat or species populations may change over time as technology changes or as on-the-ground inventories are conducted. Inventories are updated at the project level.

Changes between the publication of the assessment and proposed action

The analysis of existing conditions and trends contained in the Assessment, in the affected environment sections of this DEIS, and in the planning record, provides a context for comparison for desired future conditions which is the foundation for sustainability of ecosystems on the Flathead National Forest. In the Assessment, the Terrestrial Ecosystem and Aquatic Ecosystem sections reported on conditions for specific wildlife species using 3 categories including: 1) Threatened, endangered, proposed, and candidate species; 2) potential species of conservation concern; and 3) species of public interest. Because the planning process occurred over a time period of a few years, the status of species has evolved for a variety of reasons:

- the Assessment was based upon draft planning rule directives and since its publication, the USFS has published final directives,
- a change in the status of endangered, threatened, candidate, or proposed species under the Endangered Species Act,
- species of conservation concern have been identified by the Regional Forester,
- the best available scientific information, models, and model outputs have been further evaluated and/or updated.

The DEIS updates information provided in the Assessment, as applicable.

3.7.4 Wildlife diversity

Diverse ecosystems on the Flathead National Forest support close to 300 species of wildlife. The following sections assess wildlife diversity, associated ecosystems/key ecosystem characteristics, and consequences of alternatives:

- Aquatic, wetland, and riparian habitats
- Hardwood tree habitats
- Cliff, cave, and rock habitats
- Grass, forb, shrub habitats
- High elevation habitats including persistent spring snow
- Coniferous forest habitats and their connectivity
- Old growth, late successional forest, very large live and dead trees greater than 20 inches d.b.h.
- Dead trees less than 20 inches d.b.h., including burned forest

Wildlife associated with aquatic, wetland and riparian habitats

Introduction

Aquatic, riparian, and wetland ecosystems are abundant and highly diverse on the Flathead National Forest (see figure B-06). There are about 175 species on the Forest that use these habitats for feeding, breeding, and or shelter (see revised forest plan appendix D). The Confederated Salish and Kootenai

Tribes identified a particular concern for wetland habitats and associated wildlife in their Climate Change Strategic Plan (CSKT 2013). The Montana Department of Fish, Wildlife, and Parks also expressed a particular concern for wetlands and associated wildlife in their State Wildlife Action Plan (MFWP 2015). MFWP identified floodplain and riparian areas, wetlands, and open water as tier I community types of greatest conservation need in every ecoregion within the state because of: 1) the biodiversity found in these landscapes; and 2) the importance of water during life cycles of wildlife species.

Specific to the Forest, for example, an assessment of bird biodiversity on all lands in the Flathead River basin was completed based upon research conducted at the Landscape Biodiversity Lab at Montana State University (Mehr and Jones 2005). The authors stated that the Flathead River basin has higher bird richness than all but one other area within the "Yellowstone to Yukon" ecoregion. Examples of bird species associated with aquatic, riparian, and wetland habitats include a variety of waterfowl and shorebirds; the American redstart, bald eagle, Wilson's warbler, northern water-thrush, catbird, winter wren, great blue heron, and long-billed marsh wren. Several species of mammals such as moose and numerous species of bats, such as the long-eared and long-legged myotis, forage within or above aquatic, wetland and riparian communities.

Examples of key ecosystem characteristics for some aquatic wildlife species are associated with fast-moving streams (e.g. deep pools for escape from predators, down logs or large rocks used for nesting or loafing, and high water quality that supports abundant aquatic insects for food). Down logs are provided by trees in riparian areas falling into the stream, which are in turn affected by processes such as wildfire, insect and disease, or timber harvest. Key ecosystem characteristics for other species are associated with conditions in larger lakes (e.g. deep water for diving to avoid predators or catch fish, and shoreline conditions that provide gentle terrain and vegetation for nesting). Key ecosystem characteristics for other species are associated with conditions in wetlands (e.g. a variety of submergent, emergent, or other low-growing plants that provide cover as well as plants and high densities of invertebrates for food).

Six species are discussed as examples below in order to help display differences in effects of alternatives, but effects to other species associated with these habitats may be similar. The six species are the black swift (SCC), harlequin duck (SCC), beaver, northern bog lemming, boreal toad, and bald eagle. In addition to coarse filter plan components, there may be species-specific plan components to address the needs of these species. The first part of this section describes key stressors and consequences that are applicable to Riparian Management Zones (RMZ's) surrounding aquatic, riparian, and wetland ecosystems on the Forest and then key stressors and consequences specific to species are described.

Key indicators for analysis of most wildlife associated with aquatic, wetland and riparian habitats

There is a requirement in the 2012 planning rule to maintain or restore the ecological integrity of riparian areas, "including plan components to maintain or restore structure, function, composition, and connectivity …" (219.8(a)). In addition to key indicators and effects addressed in the Soil, Watershed, Aquatic Species, and Riparian Ecosystems sections of the DEIS (section 3.2) and vegetation (section 3.5), the following indicators and effects are important for the wide variety of wildlife species associated with aquatic, wetland and riparian habitats (also see the species-specific section for fisher). The indicators were developed after considering key stressors, public comments, and issues identified during scoping.

- Connectivity for wildlife provided by RHCAs (alternative A) or RMZs (alternatives B, C, and D)
- Diversity of successional stages in riparian areas

Affected environment

The Forest has abundant aquatic, riparian, and wetland habitats compared to many other national forests in Montana (see the Aquatics section of Chapter 3 for more details). The Forest mapped riparian habitat conservation areas (RHCAs) around rivers, streams, lakes, reservoirs, ponds, and a wide variety of wetlands for the assessment. RHCAs range from about 12% of NFS lands in the Salish Mountains GA to 17% of NFS lands in the Swan Valley GA (see Forest Assessment 2014).

On wide, low gradient rivers (e.g. the Swan River), periodic flooding maintains a very highly convoluted pattern of meanders, sloughs, and oxbow lakes. Because this pattern is changing constantly due to periodic flooding, early successional vegetation, including shrubs, forbs, grasses, and young hardwood trees, are maintained by natural flood processes. Beaver activity also helps to maintain non-coniferous vegetation by raising the water table.

On Forest lands, many upland riparian areas are dominated by coniferous forests, although early successional plants are maintained by high water tables in some areas. On streams with a higher gradient, early successional stages including shrubs, forbs, grasses and young hardwood trees have historically been promoted by wildfire, insects, and disease.

Early successional openings in riparian areas are required by some wildlife species, while other species require late successional stages and forest cover. Based upon vegetation modeling, the natural range of variation (NRV) for early successional openings in RHCAs ranges from about 2.4%-8% (8,000-33,000 acres) of the total RHCA acres on NFS lands, with variation due to processes such as wildfire, insects and disease. Current levels are near the middle of the range (about 24,000 acres)(appendix 3).

The affected environment section describes key ecosystem characteristics. The key stressors section which follows provides a foundation for the alternative effects analysis and an understanding of which stressors the USFS has authority to manage. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are activities that might impact a species and its habitat if not managed or mitigated. Stressors that are outside of Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. These are considered under "cumulative consequences".

Key stressors under USFS control

Land Management: Land management actions on all lands including vegetation, fire and fuels management, roads, energy and minerals, grazing, invasive species, and recreation can affect species associated with these habitats.

Key stressors not under USFS control

Land Management and Development: Activities on other land ownerships or controlled by other management agencies that may affect aquatic, wetland and riparian wildlife habitats include water diversion, flood control, stream channel manipulation, hydropower management, livestock grazing, farming, timber harvest, fire and fuels management, recreation, housing sub-division, commercial development, as well as introduction of invasive species and their chemical treatment (see section of 3.2 for more details).

Climate Change: Climate models show that changes in climate are anticipated to decrease runoff, groundwater infiltration, and availability of wetland habitats (especially those that are smaller in size). Water temperatures are likely to increase with increasing summer air temperature and decreased late summer stream flows. Decreases in snow water equivalence and advances in spring runoff throughout the Pacific Northwest have already been well documented (Stewart et al. 2004). In the central Rocky Mountains, snow pack, rate of spring warming, and spring precipitation are the primary drivers of spring runoff severity (Stewart et al. 2004). Changes in the timing or amount of runoff may affect aquatic, wetland, and riparian nesting species, but their ability to adapt to higher variability or more prolonged periods of variability is unknown.

Summary of the alternative consequences

Riparian areas with special management direction are called riparian habitat conservation areas (RHCAs) for alternative A or riparian management zones (RMZs) for alternatives B, C, and D. With all alternatives, plan components for aquatic ecosystems help to provide high habitat quality (see Soil, Watershed, Aquatic Species, and Riparian Ecosystem section of the Revised Forest Plan and DEIS Chapter 3 for more details), benefitting wildlife associated with aquatic, wetland, and riparian habitats. All alternatives would promote connectivity in RHCAs/RMZs (see figure B-06). For wildlife, differences in alternatives are primarily related to RHCA/RMZ widths and riparian habitat diversity within RHCAs/RMZs.

To look at RHCA diversity, ERG modelled consequences of alternatives, differentiating between low gradient riparian areas along rivers and streams that are maintained by flooding, versus those in upland areas that are controlled by bedrock and affected primarily by forest succession, fire suppression, wildfire, insects/disease, and vegetation management activities. ERG modelled the amount of early successional habitat in upland RHCAs, including a warmer/drier climate over the next five decades, using the fire suppression logic associated with the model (Appendix 3).

The model predicts all alternatives would stay within the minimum and maximum range of NRV over the 5 decade time period. Acres of riparian habitat in an early successional stage declines the most from current levels with Alternative A over the 5 decade period (from about 24,000 acres to about 10,000 acres). These changes would decrease the quantity of habitat for riparian wildlife species associated with dense shrubs, grasses, forbs, and young hardwood trees. These changes would benefit riparian wildlife species associated with mature coniferous forest cover. With alternatives B and D, levels fluctuate but remain near current levels by the end of decade 5. With alternative C, the amount of early successional forest increases above current levels by the end of decade 5. Alternative C has more MA1b (recommended wilderness), with lower levels of fire suppression and no salvage harvest. Alternative C would provide the most habitat for wildlife species associated with riparian areas in an early successional stage, but the least habitat for species associated with mature forest in riparian areas (see Appendix 3 for more details).

Environmental consequences alternative A

With alternative A, plan direction associated with Amendment 21, the INFISH amendment, and MA 12 (riparian areas) benefits many, but not all, wildlife species. Plan standards direct the USFS to minimize disturbance of riparian ground cover and vegetation in RHCAs. Because of this emphasis, RHCAs have been treated as buffers in many areas of the Forest and timber harvest has generally not been allowed. Forest interior species have benefited by dense forest cover along perennial fish-bearing streams, where RHCA widths are at least 300 feet on either side of the stream, because they benefit by patches of forested habitat that are further from an edge (for more details, see individual species sections below). While prescribed fire use is allowed in RHCAs, valley-bottom RHCAs are often in areas intermingled with homes where prescribed fire use may create conflicts. Lack of timber harvest and prescribed fire in some RHCAs reduces habitat for species associated with riparian shrubs, deciduous trees, grasses, and forbs.

Environmental consequences alternatives B, C, D

Alternatives B, C, and D have forestwide desired conditions FW-DC-WTR-01, 03, 10, and which support biodiversity because they specify that: 1) habitat and ecological conditions support self-sustaining populations of native aquatic and riparian associated plant and animal species, and 2) National Forest System lands provide the distribution, diversity, and complexity of watershed and landscape-scale features including natural disturbance regimes and the aquatic and riparian ecosystems to which species, populations, and communities are uniquely adapted. Watersheds and associated aquatic ecosystems retain their inherent resilience to respond and adjust to disturbances without long-term, adverse changes to their physical or biological integrity (FW-DC-WTR-02, 03, 10, 11, 12).

Forestwide standard FW-STD-RMZ-01 would establish similar riparian management zones as alternative A, however they are now known as riparian management zones (RMZs). With alternatives B, C and D, RMZ widths would be defined the same as alternative A, except for wetlands. With alternative A, wetlands less than an acre in size have an RHCA width of 100’ for priority watersheds and 50’ for non-priority watersheds, while wetlands greater than an acre have an RHCA width of 150’. With Alternatives B, C, and D, FW-STD-RMZ-01 increases the width of RMZs for mapped wetlands to 300’. This standard, to extend the RHCA width for wetlands, is beneficial for wildlife because wetland areas provide key habitat and there would be greater emphasis on managing the area surrounding wetlands to achieve wildlife habitat objectives, including diversity and habitat connectivity.

Three primary forestwide standards would apply to RMZs:

02 Ensure vegetation management activities proposed within RMZs are consistent with state law (e.g. Montana Streamside Management Zone Law; see appendix C).

03 Vegetation management can only occur in the inner RMZ, when necessary to maintain, restore or enhance aquatic and riparian associated resources.

04 Vegetation management can only occur in the outer RMZs, so long as project activities in RMZs do not result in long-term degradation to aquatic and riparian conditions.

Management can occur within RMZs with stricter criteria/scrutiny occurring in the inner half of the RMZ (that portion closer to the stream). Examples here may include pre-commercial thinning to stimulate growth of larger trees or trying to develop a larger hardwood component within the stand.

Commercial harvest is allowed within the inner half however, it will be more of a tool in the outer half of RMZs and cannot result in long term degradation of aquatic and riparian resources.

Plan components do not differ between alternatives B, C, D therefore effects should be the same, and however alternative C will have more timber acres harvested over the first two decades as modelled by Spectrum. It is difficult to determine where harvest will occur as this EIS is programmatic but Alternative D has more suitable base acres in 6b and 6c which would occur in the Salish and Swan Geographic areas.

Desired condition FW-DC-WL-SOI-02 states that cover conditions in RMZs (see figure B-06) provide shade and contribute to habitat connectivity for a variety of wildlife species that use riparian areas for movement corridors (e.g. marten, also see fisher). Desired condition FW-DC-WL-SOI-03 states that RMZs have highly diverse structure (including large down wood, snags, and decadent live trees) and composition (including shrubs and deciduous trees) to support numerous bats and other mammals, bird, reptile and amphibian species which feed, nest, den or roost near water.

In addition, the following plan components support most wildlife species associated with aquatic, wetland and riparian habitats.

<u>Consequences from grazing:</u> Cattle grazing can alter riparian diversity by changing the composition or abundance of grass, forbs, shrubs, and hardwood trees and can spread invasive plants in RMZs. On the Forest cattle grazing is a minor activity. Grazing allotments occur in only two of seven GAs: the Swan Valley and Salish Mountains GAs. Alternatives B, C, and D include grizzly bear plan components that

limit cattle grazing in all but the Salish Mountains GA. Plan components FW-DC-GR-03, FW-STD-GR-08, 09 and FW-GDL-GR-03, 04, and 05 promote riparian habitat diversity and connectivity. The Swan GA has guideline GA-SV-GDL-07 to phase out cattle allotments if opportunities arise with a willing permittee, which would reduce the risk of impacts due to grazing on NFS lands.

Consequences from energy and minerals: Energy and mineral development can alter riparian diversity and connectivity. FW-GDL-E&M-07 and 08 specify that all proposed mineral operations should avoid Riparian Habitat Conservation Areas (or RMZs) and if they cannot be avoided, then all practicable measures should be used to maintain, protect, and rehabilitate fish and wildlife habitat which may be affected by the operations. Sand and gravel mining and extraction are prohibited within RMZs, with very limited exceptions.

Consequences from roads: Roads can alter riparian diversity and connectivity, especially if they parallel streams. Standard FW-IFS-STD-02 and guidelines FW-IFS-GDL-02 and FW-GDL-RMZ-03 limit roads in RMZs, except at crossings. In addition, FW-GDL-CNW-01 specifically limits roads in the conservation watershed network. Standard FW-STD-WTR 02 reduces the risk of road impacts by specifying that project-specific best management practices (BMPs, including both Federal and the State of Montana BMPs) shall be incorporated in land use and project plans as a principle mechanism for controlling non-point pollution sources, to meet soil and watershed desired conditions, and to protect beneficial uses. This management direction would benefit a variety of wildlife species by maintaining aquatic and riparian habitat quality.

Consequences from recreation developments or uses: Recreation developments can alter riparian diversity and connectivity. Guidelines FW-GDL-REC 07 and FW-GDL-REC 08 provide direction to reduce effects to riparian resources which would benefit wildlife habitat diversity and connectivity.

Consequences from vegetation management: Vegetation management can affect riparian diversity and connectivity, depending upon the type and amount of harvest. Harvest that promotes patches of deciduous trees, shrubs, forbs, and grasses, while maintaining diverse forest structure, function (such as insect/disease or fire that is consistent with the natural range of variation), and connectivity, can be beneficial to wildlife species. With alternatives B, C, and D, RMZs are not suitable for timber production. Timber harvest is allowable in the inner half of an RMZ if it benefits fish and wildlife and is allowable in the outer half of an RMZ if it increases forest resilience and does not result in long-term degradation. In addition, FW-STD-RMZ-02 limits clearcut regeneration harvest and prescribed burning in RMZ's, which would promote connectivity for most wildlife species.

Consequences from fire and fuels management

Fire and fuels management can affect riparian diversity and connectivity, depending upon the size and severity of the wildfire. In general riparian vegetation on the forest floor is consumed, cover is reduced, and connectivity is reduced. Prescribed fire can help reduce effects of wildfire by reducing fuels and the intensity or extent of wildfire when it occurs. Because of the mosaic pattern prescribed fire produces, trees and large down woody material used by some wildlife species for cover and connectivity may remain. Chemical fire retardants used in wildfire suppression can help to protect riparian diversity and connectivity, but can have impacts on aquatic species, but their use in riparian areas is restricted. Guideline FW-GDL-RMZ-04 protects aquatic, wetland, and riparian habitats and associated species because it states that aerial application of chemical retardant, foam, or other fire chemicals and petroleum should be avoided in mapped aerial retardant avoidance areas (see glossary) in order to minimize impacts to the RMZ and aquatic resources.

Consequences from invasive species management

Herbicides used to control invasive species can affect riparian diversity, depending on the type, extent, and amount of herbicide that is used; and the proximity to a water body, wetland, or riparian area. Effects to wildlife species may occur due to direct contact if chemical concentrations are high enough. In addition, pesticides can cause indirect effects by decreasing aquatic insects that provide food for wildlife. Standard FW-STD-RMZ-06 reduces risks to wildlife associated with aquatic, wetland, and riparian habitats because it states that herbicides, pesticides, and other toxicants and chemicals should only be applied within RMZs if needed to maintain, protect, or enhance aquatic and riparian resources or to restore native plan communities. Guideline FW-GDL-NNIP-01 also reduces risks to wildlife because it states that non-native invasive plant treatments within RMZs should consider use of mechanical, biological, and cultural means of control before chemical control methods.

Cumulative consequences to most species associated with aquatic, wetland and riparian habitats

This section summarizes activities and effects that are common to most species associated with aquatic, wetland, and riparian habitats. Also see the individual "Cumulative Effects" sections specific to species in the wildlife analysis of this DEIS.

Historically, much of the private land in the valley-bottom was cleared for grazing and farming, reducing native riparian vegetation, but maintaining open space used by wildlife. As private lands land in the Flathead Valley become more valuable for development, its relative value for livestock grazing or farming may decline, resulting in less open space and more subdivision for commercial or residential development. Private property on the shores of large lakes, rivers, and streams is highly sought after. This reduces the connectivity in and between riparian areas and upland areas. Developments may reduce habitat and increase disturbance near nest sites.

Many land managers now work together to protect and restore the high quality aquatic, wetland, and riparian habitats of the Flathead region.Numerous acquisitions and conservation easements have been completed along lakes, rivers, and streams by groups and individuals such as MFWP, Stoltze Land and Lumber, and by the Nature Conservancy (the Legacy Lands formerly owned by Plum Creek Timber Company). All of these provide for conservation of wildlife habitat. MFWP continues to actively pursue conservation easements on private lands to limit loss of riparian habitats (G Bissell, MFWP pers. comm. 2014).

In the future, loss of habitat associated with human developments on some private lands is likely to continue and may increase as the human population in the Flathead Valley grows. Newlon and Burns (2010), with MNHP, completed an analysis of wetlands in the Flathead Valley using remote sensing and photo interpretation techniques. Their study area encompassed private lands, MT DNRC, MFWP, Forest, USFWS lands, and former Plum Creek Timber Company lands. About 24,255 acres of wetland and riparian habitats were mapped on private lands and about 8,129 acres were mapped on public lands (including wildlife refuges managed by the U. S. Fish and Wildlife Service). Their preliminary analysis showed relatively little overall change in wetland area between 1981 and 2005, but they found changes in wetland functional capacity and land cover types around wetlands. Changes included relatively large areas of forest and grassland/shrub cover types that have been converted to agricultural and urban land cover types on private lands.

Laws governing protection of lakes, streams and wetlands apply to all land ownerships. In addition, Lake and Lakeshore Protection Regulations are identified within the Flathead County Growth Policy (adopted March 19, 2007) as an implementation tool, serving to promote public health and safety, maintain water quality and preserve public water bodies and natural resources available the citizens of Flathead County. County policy P10.5 protects wetlands and riparian areas. P5.5 restricts industrial uses that cannot be mitigated near incompatible uses such as residential, schools and environmentally sensitive areas such as wetlands, floodplains, riparian areas, areas of shallow groundwater, etc. County policy P19.4 recognizes riparian buffers for their recreational value and their ability to protect the quality of water along major streams and rivers in the County in order to enhance recreational opportunities, protect the quality of water (reduce erosion; surface runoff containing pesticides, fertilizers, etc.; stream bank depredation/defoliation; etc.) and their ability to protect the natural aesthetics of waterways.

In addition, on national forest system lands, cumulative effects are addressed through plan components in the Forest Plan. Many landowners implement best management practices (BMPs) and other watershed conservation practices. Lands managed by the Montana Department of Natural Resources and Conservation (e.g. Swan State Forest, Coal Creek State Forest, and Stillwater State Forest) are addressed by the DNRC Habitat Conservation Plan. On DNRC lands, riparian habitats are protected during riparian timber harvest by establishing a riparian buffer equal to the 100-year site index tree height along Class 1 streams (MTDNRC 2010; MTDNRC 2011). Streamside management zones (SMZs) on private timber lands are managed to protect water quality and reduce cumulative effects on streams, but the width of these areas is smaller and some activities do not have as many restrictions as on NFS lands. Timber harvest does not occur in riparian areas in Glacier National Park (GNP), but trees may be removed to provide for human safety. Cumulatively, vegetation management on NFS, state, GNP, and some private lands contributes to aquatic, wetland and riparian habitats and their connectivity.

The Confederated Salish and Kootenai Tribes developed a comprehensive wetlands conservation plan for the Flathead Reservation, adjacent to the Forest, adopted by Council in 1999. The interim and long terms goals of the plan are a synthesis of Tribal goals for wetlands and riparian lands articulated in prior plans, strategies, ordinances, consent decrees, environmental standards, and best management practices, including shoreline protection, aquatic and wetlands conservation, noxious weed management, water quality standards, Kerr Dam mitigation and management, lower Flathead River corridor management, non-point source assessments, and watershed plans.

Glacier National Park’s general management plan (1999) addresses aquatic habitats. Research projects as well as restoration projects, are ongoing.

Historically, wildfires were instrumental in creating dense riparian shrub and deciduous tree communities, but development of river valleys and adjacent private uplands has placed a high level of emphasis on fire suppression (see section of Chapter 3 on Fire and Fuels for more details). As more people inhabit areas in and adjacent to riparian areas, there may be more clearing of fuels for fire protection on private or state lands, as well as on intermingled or adjacent NFS lands. Drought, disease, insects, and/or wildfires may continue to have effects on riparian wildlife habitat.

Mining is expected to continue to be a minor land use on Forest lands and the potential for mining on state and private lands is also expected to be low (see section of Chapter 3 on Energy and Minerals for more details).

In the West, impoundments have interrupted the natural flood cycle of rivers to the detriment of cottonwood/shrub communities. The only large impoundment affecting Forest lands is the Hungry Horse Dam and Reservoir, completed in 1953, which provides hydropower and flood control. The Hungry Horse Dam inundated a segment of the South Fork of the Flathead River and flooded an estimated 6,867 acres of riparian/wetland wildlife habitats, according to MFWP. MFWP has a mitigation program for this habitat loss which is beneficial for wildlife (see Forest Assessment for more details).

Introduction of aquatic invasive species or contaminants in water bodies resulting from recreational, agricultural, or industrial activities may have negative impacts on species associated with aquatic, wetland, and/or riparian habitats. The potential for introduction of disease and aquatic nuisance species exists on all lands within the cumulative effects analysis area, often as an indirect result of water-based recreation. Multiple management agencies have increased inspections and public education efforts in recent years in order to reduce these risks.

In summary, the cumulative effects of proposed management direction on the Forest (see section 3.2.10 for more details), in the context of all lands of the larger landscape, include contributing to the ecological integrity of aquatic, wetland, and riparian wildlife habitats in a substantial portion of watersheds in the larger Flathead watershed. This would be accomplished by plan components to protect water quality, quantity, and riparian management zone integrity, applying best management practices, providing connectivity, protecting habitats from development, providing for natural flood and groundwater infiltration processes, and restoring areas impacted by invasive species and other past management activities.

Black Swift (SCC)

Key indicators for analysis

In addition to the indicators and effects of alternatives described under "Wildlife associated with aquatic, wetland and riparian habitats", "watersheds" and "riparian management zones" the following species-specific indicator applies to black swifts:

- Management Direction to support key ecosystem characteristics for black swift nesting habitat and reduce the risk of disturbance near active nesting colonies.

Affected environment

Population, life history, habitat, and distribution

This species is listed as a species of conservation concern by the regional forester (see www.fs.usda.gov/goto/flathead/SCC). The black swift is a neo-tropical migratory bird that winters in Central and South America. During the breeding season, black swift distribution is most widespread in British Columbia and western Alberta, with spotty distribution in western states from Alaska to southern California and east to Colorado. The black swift is present on the Forest only during the breeding season.

A total of almost 50 sites were surveyed by MFWP in 2015. As of 2015, there were a total of 7 known nest sites in northwest Montana outside Glacier National Park on national forest or CSKT lands (C. Hammond pers. comm. 2015) and 6 known nest sites in Glacier National Park(Glacier National Park unpublished report 2013). On the Forest, there is one known nesting site at Lower Holland Falls in the Swan Valley geographic area (Anderson and Turnock 2012).

Marks and Casey surveyed waterfalls for black swift nests in 2004 (Hendricks 2005), visiting 32 potential nesting sites on the Flathead National Forest and adjacent areas of western Montana. Marks and Casey listed 9 potential nesting waterfalls on the Forest (see planning record exhibit V-4)(using a criteria that that waterfalls were at least 20 feet tall), in all geographic areas except the North Fork Flathead River GA or the Hungry Horse GA (Hendricks 2005). All identified potential black swift nest sites on the Forest are in class 1 watersheds. Class 1 watersheds are those which exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition (also see Aquatics section of the DEIS). There is no information on the natural range of variation for black swift nesting habitat in Montana.

Many potential nest sites in northwest Montana have not been surveyed (C. Hammond pers. comm. 2016). Swifts are hard to detect because of their fast erratic flight and little to no vocalization. This makes point counts and other standard bird monitoring techniques ineffective (Casey 2004). In addition, monitoring breeding sites is generally difficult because of dangerous access and the cryptic nature of colony sites (Casey 2004, Marín 1997). Colonies typically consist of only 1 or 2 nests making observation of many breeding swifts logistically challenging (Hirshman et al. 2007). Colonies are also difficult to document because adult birds infrequently visit the nest (Casey 2004 *IN* Anderson and Turnock 2012).

The closest study of black swifts is in Glacier National Park, adjacent to the Forest, where the species had fairly high nest failure rates, with no evidence of re-nesting after nest failure (Hunter and Baldwin, Hunter and Baldwin 1972). Adults show strong nest site fidelity, using the same nest for a decade or more (Levad et al. 2008). The black swift is unique among swifts in incubating only one egg per clutch (Hirshman et al. 2007). The black swift has a low reproductive rate, but is relatively long-lived. Wiggins (2004) reports a maximum recorded longevity of 16 years and provides a reasonable estimate of annual survival at 88-92%. Survival of adults is likely the most important factor in regulating black swift population growth. There is no population estimate, trend, or density available for Montana.

Nesting sites for the black swift are geologically limited. Black swifts nest on ledges or in shallow caves on steep rock faces behind tall waterfalls (Hirshman et al. 2007) — a very limited and specialized habitat. Known nesting locations have high topographic relief, inaccessibility to predators, unobstructed flyways to and from the nest, and darkness for most of the day (Hunter and Baldwin 1962). Increasing stream flow, number of potential nest platforms, amount of available moss, shading of potential nest niches, topographic relief of surrounding terrain, and ease of aerial access to potential nest niches contributed to a higher probability the site would be occupied by black swifts (Levad et al. 2008). Nestlings have generally been observed from mid-July to mid-August, but Glacier National Park researchers observed fledging in late September 2011, a year with unusually high snowpack and late runoff (L. Bate pers. comm. 2015).

Black swifts forage on flying insects over wide areas in the mountains and descend to valleys to feed over rivers, lakes, and meadows; sometimes long distances from the nest (Marín 1997). Most of the black swift observations in the planning area are of feeding birds along the North Fork and Middle Fork of the Flathead River adjacent to Glacier National Park as well as in the main Flathead River Valley, Swan Valley, and Stillwater Valley. The nesting locations of these birds are unknown, but there are likely black swift colonies in Montana that are as yet unidentified (Anderson and Turnock 2012)The affected environment describes key ecosystem characteristics associated with a species. The key stressors section which follows provides a foundation for the alternative effects analysis and an understanding of which stressors the USFS has authority to manage. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are activities that might impact a species and its habitat if not managed or mitigated. Stressors that are outside of Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. These are considered under “Cumulative Consequences”.

Key stressors under USFS control

Human disturbance

There have been no studies of the effects of human recreational activities on black swifts. Incidental observations at a swift nesting colony in a cave in southern California (Marín 1997a *IN* Wiggins 2004) and at Box Canyon Falls in Colorado (Hirshman 1998 *IN* Wiggins 2004) suggest that humans occasionally disturb black swift nesting attempts. However, both of these situations were somewhat unusual in that the nests were readily accessible to human visitors.

Key stressors NOT under USFS control

Climate change

There is currently little direct information on the factors affecting black swift populations, but the main threats appear to be the lack of late summer water runoff, which affects the suitability of nest/colony sites, and decreased local food supplies (Wiggins 2004). On the Forest, water flow over the known nesting site is dependent upon high elevation snowmelt from lands which are in wilderness and inventoried roadless areas.

Summary of Alternative Consequences

Most characteristics of black swift nesting habitat are a function of topographic conditions and are not affected by NFS management. With all alternatives, management area designations support ecological conditions for nesting by black swifts at the known nesting site. Alternatives differ with respect to management areas (MAs) on lands adjacent to the known nest site, but these differences are expected to have minor effects because both MAs have a very low potential for human activities that could cause disturbance to nesting black swifts. There are no studies on black swifts and human disturbance. With alternatives B and C, the nest area is in an Inventoried Roadless Area with a MA1b designation (recommended wilderness). With alternatives A and D, the management designation is MA5a (back-country non-motorized year-round).

Environmental consequences alternative A

RHCA management direction has supported most key ecosystem characteristic for black swifts because it provides protection for riparian habitat within 300 feet of perennial streams that flow into waterfalls providing potential black swift nestin habitat and supports ecological conditions that provide feeding habitat. However, the 1986 forest plan does not specifically address human disturbance of black swift nesting colonies.

Environmental consequences alternatives B, C, and D

Key ecosystem characteristics described in the affected environment would be supported by implementation of plan components for soil, watershed, aquatic species, and riparian ecosystems included in all action alternatives (see section above and 3.2.10 for more details). Guideline FW-GDL-WL-SCC-04 specifies that measures to limit disturbance from project implementation should be applied at active nesting sites of black swifts from mid-April to mid-August, reducing the risk of disturbance that could impact nesting. This would apply to activities such as chainsaw use or prolonged activity at the nest site that could create unusual levels of noise uncharacteristic of a nest area, and for which swifts may not be tolerant (also see appendix C).

Cumulative consequences

Waterfalls providing potential nesting habitat occur on national forest system lands as well as CSKT tribal lands and Glacier National Park lands adjacent to the Forest. There are no known waterfalls suitable for nesting on state or private lands.

The natural range of variation for waterfalls providing potential black swift nesting habitat is unknown, but droughts undoubtedly affect habitat on a periodic basis and nesting birds have persisted. Past actions on the Forest have maintained Class 1 watershed condition for all areas with waterfalls believed to be suitable for nesting.

In the future, the potential combination of less snow pack and earlier spring snowmelt has the potential to cause lower late summer flows. Changes in climate could cause some waterfalls to dry up before black swift young have fledged from the nest. Data from four snow telemetry (SNOTEL) sites on the Forest present a flat to slightly-decreasing trend in April 1 peak snowpack from 1983-2012 (see Forest Assessment figure 14). The four sites show varying trends in total water year precipitation, with the high elevation site (Noisy Basin – 6,040 feet) exhibiting an upward trend while the three sites at lower elevations (4,350 to 5,035 feet) appear flat to downward (see section 3.2.10 of the Forest Assessment and DEIS for more details).

In a 2012 survey of previously known nesting sites in Montana, one previously occupied site was believed to be unoccupied. One colony at Haystack Creek in Glacier National Park is monitored frequently and supported three active nests in the past. In 2013 only two nests were active and in 2014 only one nest was active (L. Bate, Glacier National Park biologist, pers. comm. 2015). Whether this may be due to natural changes in water flow or human disturbance is unknown. Continued monitoring is needed to determine whether this change in active nesting is a long-term trend or whether it represents a normal level of variation.

There is a non-motorized recreation trail that has accessed the base of Holland Falls below the known nest for decades. According to Anderson and Turnock, it is probable that the colony has been there for some time and gone unnoticed by casual visitors (Anderson and Turnock 2012). Despite the existence of the trail, the black swift nesting colony has not abandoned this nesting site, therefore, black swifts appear tolerant of this existing use and the pattern of recreationists moving along the trail. The rock at Holland Falls is fractured and not suitable for rock climbing (J. Dunham, recreation specialist, pers. comm. 2016).

There are several potential and one known nest site on CSKT lands (adjacent to the Forest) in the Tribal Mission Mountains Wilderness. In Glacier National Park and the Mission Mountains Tribal Wilderness, many waterfalls are difficult to access so risks of disturbance to nesting black swifts are very low.

In summary, the cumulative effects of the proposed forest plan alternatives, in the context of all lands of the larger landscape, would contribute to the ecological integrity of aquatic, wetland, and riparian wildlife habitats that support black swifts. This would be accomplished by a forestwide plan component to limit the risk of disturbance near any known nest sites during the nesting season, and designation of management areas upstream of and surrounding the known nest site that helps to protect nesting (MA1b Recommended Wilderness or MA5a Backcountry Non-motorized Year-round). The abundance and distribution of potential nesting habitat on the Forest is naturally limited by geology that creates rock cliffs and waterfalls, and this limits the ecological capacity to provide nesting habitat. While the Forest does not have the ecological capacity does not have authority over key stressors (such as drought and climate change) that may affect the black swift, the Forest contributes to the ecological conditions that support them.

Harlequin Duck (SCC)

Key indicators for analysis

In addition to the indicators and effects of alternatives described under “wildlife associated with aquatic, wetland and riparian habitats” “watersheds” and “riparian management zones”, the following species-specific indicator applies to harlequin ducks:

- Management direction to support key ecosystem characteristics of potential nesting stream reaches and reduce the risk of human disturbance of harlequin ducks on known nesting stream reaches.

Affected environment

Harlequin duck population, life history, habitat, and distribution

This species is listed as a species of conservation concern by the regional forester see www.fs.usda.gov/goto/flathead/SCC). The breeding season range of the Pacific population of harlequin ducks occurs across most of Alaska and British Columbia, as well as portions of the Yukon, Washington, Oregon, Idaho, Colorado and Montana. The harlequin duck is an uncommon and localized breeder in Montana and is at the eastern edge of the range of the Pacific population, which extends south to northwest Wyoming. Harlequin ducks are small sea ducks that spend most of the year in near-shore sea environments, but move inland to fast-moving streams to breed. They form lifelong pair bonds on the coastal wintering grounds and then pairs migrate to the stream where the female was born (Hansen 2014).

About twenty-five percent of known breeding harlequins in northwest Montana nest along a 10 mile reach of McDonald Creek in Glacier National Park (Reichel and Genter 1996), adjacent to the Forest. There is little or no information about harlequins in Montana prior to the late 1980s, and currently available information is not sufficient to detect population trend. The Glacier National Park (GNP) population appears to be stable, but the population outside GNP appears to be in decline (C. Hammond MFWP pers. comm. 2016). In 1996, Reichel estimated that the statewide population of Harlequin ducks in Montana ranged from 150-200 pairs. There is no subsequent population estimate.

Historically, harlequin duck nesting was known to occur in 5 of 7 Forest geographic areas (GAs)(Reichel and Genter 1996). Numerous broods have been consistently detected in Trail Creek in the North Fork Flathead River GA and in Spotted Bear River in the South Fork Flathead River GA. Other GAs have not been surveyed as consistently, but broods have also been observed in the Middle Fork and Hungry Horse GAs. There are no records of harlequin duck nesting in the Salish Mountain or Swan Valley Geographic Areas and these geographic areas are not considered to be potential habitat.

Like many other sea ducks, male harlequins depart the breeding grounds immediately after females begin incubation, so females do not frequently re-nest in the event of a nest failure (Bate 2013). Relative to many other species of ducks, harlequins occur at very low population densities on their breeding grounds and exhibit high breeding site fidelity, low reproductive rates, and delayed reproduction (Wiggins 2005) and thus may be susceptible to local extirpations (NatureServe 2007). Bond and others (2009) estimated survival probability for 144 adult female harlequin ducks at 4 breeding areas in western North America. They found that survival was lowest during incubation, with the highest number of mortalities attributed to predation. Adult survival likely drives population dynamics. If a nesting pair is lost, the habitat may not be occupied by another pair in that or subsequent seasons.

In 2014, MNHP and other cooperators carried out a systematic survey of harlequin ducks on streams in Montana where they have been known historically to breed. This effort detected a total of 31 broods with 126 chicks on 17 of 49 streams that were surveyed (B. Maxell, MNHP, pers. comm. 2014). Because harlequins are on their nesting streams early in the season, nesting success may be affected by changes in water flow. In Glacier National Park, breeding pairs inhabit upper McDonald Creek from late April through mid-June, and females with broods are on the creek during July, August and early September. Late spring high water flows in 2014 may have caused reduced detectability or failed reproduction on some streams where breeding has been observed in the past (L. Bate pers. comm. 2014). In Montana, nesting has not been monitored long enough or consistently enough in some areas to know if climatic variation causes harlequins to move or causes nest failure, and if so, how many years of nest failure they may be able to tolerate before a female would no longer return to a stream reach (see project file exhibit V-5). There is no information on the natural range of variation for harlequin duck nesting habitat.

During the breeding season, harlequin ducks use clear, low gradient, fast moving mountain streams with abundant aquatic insects. Females are known to lay eggs in a wide variety of microsites including cliffs, under down logs in burned areas, on instream logjams, or on streambanks with thick shrub and/or tree cover (Cassirer and Groves 1994, L. Bate pers. comm. 2014). Key habitat characteristics are high water quality, complex stream structure (including fast water to support aquatic prey, deep pools for escape, and rocks or large down logs for loafing), as well as dense vegetative or log cover on the shoreline to reduce disturbance and protect birds for from avian predators during incubation (L. Bate pers. comm. 2015). Cover also provides stream shading that promotes cool water temperatures and associated higher oxygen levels important to the aquatic invertebrates that harlequins feed upon. On the west side of the continental divide, calm back waters along rivers or beaver ponds may be important for brood rearing (Kuchel 1977, L. Bate pers. comm 2015). Harlequin broods may move downstream from the fast-moving streams where they are born to larger streams and rivers as the summer season progresses (Kuchel 1977, Cassirer and Groves 1994) and are often easier to observe at this time. A strong stream selection factor in Montana appears to be for stream reaches with at least two loafing sites per 33 feet (Kuchel 1977).

There are somewhat conflicting scientific findings regarding the effects of recreation and road-related disturbance on harlequin ducks while on nesting stream reaches. Harlequin ducks have been observed avoiding boats (e.g. rafts, kayaks) in breeding stream reaches during incubation and the first 4 weeks after hatching (Kuchel 1977, Reichel and Genter 1996). Hansen’s analysis in Glacier National Park (Hansen 2014) showed that harlequin ducks didn’t avoid high quality habitats adjacent to roads and other sites with high recreation use.

In all monitored watershed sub-basins on the Forest with known harlequin duck nesting, the overall watershed condition is high, indicating that habitat diversity and integrity for harlequin ducks on the Forest is high at the watershed scale. PIBO data monitoring has shown an improved trend in aquatic habitat in reference and managed watersheds (Kendall 2014). Habitat conditions such as large wood, pool fines, percent pools and residual pool depth have trended upwards since sampling began in 2001(see Aquatics sections of chapter 3.3.10 for more details). Some stream reaches that appear to provide suitable habitat characteristics in terms of stream characteristics and water quality are not known to be used by harlequin ducks, but only two breeding streams have been consistently surveyed and harlequin ducks can be very difficult to detect while on the nest.

The affected environment describes key ecosystem characteristics associated with a species. The key stressors section which follows provides a foundation for the alternative effects analysis and an understanding of which stressors the USFS has authority to manage. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are activities that might impact a species and its habitat if not managed or mitigated. Stressors that are outside of Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. These are considered under “Cumulative Consequences”.

Key stressors under USFS control

Land Management

USFS activities may affect instream and streamside conditions on breeding stream reaches, including effects of vegetation management on cover at nesting sites, feeding habitat quality, and disturbance or displacement of harlequin ducks due to USFS management activities.

Key stressors not under USFS control

Recreation

Recreational floating, boating, and fishing on nesting stream reaches may disturb or displace nesting harlequin ducks and is managed by MFWP.

Climate change

The effects of climate change on water flows could impact harlequin habitat. Water levels could make nesting and foraging habitat unsuitable at key times when they historically would have been suitable. Insects and disease are expected to increase with climate change and can be beneficial by creating down woody material which provides nesting cover and in-stream nest sites. However, large, stand replacing fires (also expected to increase with climate change) can be detrimental by causing temporary increases in run-off, or temporarily removing dense shrub and tree cover along stream banks (see wildlife section above and 3.2.10 for more details).

Competition with fish

There are numerous theories as to why Upper McDonald Creek has such high density of nesting harlequin ducks. One is that natural fish barriers low in the watershed limit fish density and fish size. Fish may compete with harlequin ducks for food resources. Strong correlations have been shown between harlequin duck density and fishless stream reaches (Hansen 2014)

Predation during nesting

During incubation, females and their eggs are highly susceptible to predation by avian predators as well as marten, mink, red squirrel and wolf (Hansen 2014).

Hunting

Harlequin ducks are classified as waterfowl in Montana and can be legally hunted. However, most harlequins have left Montana by the time the waterfowl hunting season in Montana begins (C. Hammond pers. comm. 2014). Hunting may occur in wintering areas.

Mortality on Pacific Ocean wintering grounds

Hunting, predation, oil spills, and other toxic pollutants on their ocean wintering grounds can kill large numbers of harlequins (Reichel and Genter 1996). Immediate bird mortality from the Exxon Valdez oil spill was high, and more than 1,000 harlequin ducks were estimated to have died as a direct result of the spill (Esler et al 2000). It took the harlequin population about 25 years to recover from the Exxon Valdez oil spill (C. Hammond MFWP pers. comm. 2016).

Habitat Inundation

Construction of dams can flood the fast-moving streams used by harlequin ducks during the breeding season.

Summary of alternative consequences

Key ecosystem characteristics described in the affected environment section would be supported by plan components for water quantity and quality as well as streamside and instream cover (also see DEIS section 3.2.10 on soil, watershed, aquatic species and riparian ecosystems). The action alternatives have plan components to limit human disturbance on nesting stream reaches during key time periods.

Environmental consequences alternative A

RHCA management direction has supported most key ecosystem characteristic for harlequin ducks because it provides protection for riparian habitat within 300 feet of perennial streams where harlequin ducks nest. RHCA management direction also supports high water quality, cover, and limits new roads in RHCAs, which may indirectly limit human disturbance of harlequin duck nesting sites. However, the 1986 forest plan does not specifically address human disturbance on harlequin duck nesting stream reaches.

Environmental consequences alternatives B, C, and D

Key ecosystem characteristics described in the affected environment would be supported by implementation of plan components for watersheds and RMZs included in all action alternatives (see wildlife section above and 3.2.10 for more details). In addition, species-specific desired condition FW-DC-WL-SCC-01 states that "fast-moving, low-gradient, clear mountain streams provide nesting sites for harlequin ducks as well as aquatic insects for feeding. Nesting stream reaches have dense cover adjacent to the stream (including live and dead trees, shrubs, and down logs) and down woody material instream. There are low levels of human disturbance on breeding stream reaches during the nesting season, until harlequin broods move to larger rivers" (also see appendix C). Guideline FW-GDL-WL-04 specifies that measures to limit disturbance from project implementation should be applied at active nesting sites of harlequin ducks from mid-April to mid-August, reducing the potential for disturbance that could impact nesting. The distance would vary depending upon site specific characteristics that would be assessed at the project level.

With all action alternatives, the two known nesting streams with the most abundant, consistent production of harlequin ducks are listed as eligible wild and scenic rivers (see appendix 5). Wild and scenic river designation could indirectly increase the level of human disturbance on harlequin nesting stream reaches by making these streams more widely known, increasing the risk of disturbance and lower nesting success (especially if by boaters or floaters). However, this designation could be beneficial to harlequin ducks by protecting the habitat characteristics that are associated with harlequin duck nesting habitat. The harlequin duck would be protected under forest plan components regardless of wild and scenic river eligibility (FSH 1909.12, Chap. 80, Secs. 83.1 and 84.3).

Cumulative consequences

In the past, construction of Hungry Horse Dam may have affected harlequin ducks on the Forest, but the magnitude of this effect is unknown. Additional streams, including the two with most consistent nesting, have been listed as eligible for wild and scenic river designation with all alternatives, so their outstanding remarkable values would be maintained. Designation of rivers as wild and scenic would prevent impoundments in the future, benefitting harlequin ducks.

Streams with the potential to provide harlequin duck nesting occur in adjacent national forests and Glacier National Park, where management supports their habitat. Recreation is likely to increase in the future on all land ownerships due to human population growth. Harlequin ducks may be sensitive to some types of human disturbance until after the first 4 weeks after hatching. Rafting and kayaking have been banned on Upper McDonald Creek in Glacier National Park since the early 1990's. MFWP has closed fishing in Trail Creek (a consistent nesting stream), Whale, Red Meadow, Coal and Big creeks, which may indirectly reduce disturbance on potential and known nesting stream reaches. The larger rivers on the Forest where harlequins are known to rear their broods (e.g. North Fork and South Forks of the Flathead River) are wild and scenic rivers where outstanding remarkable values must be maintained (Flathead National Forest, Glacier National Park 2013). River outfitter and guide service days are limited by permits, are monitored, and their re-autorization is subject to environmental analysis that includes wildlife effects.

Maintaining dense cover on nesting stream reaches also helps to reduce human disturbance and predation. Stand replacing wildfires may temporarily reduce cover on all land ownerships, but may later increase down wood which provides cover for nesting harlequins. Natural stream barriers provided by habitat features such as steep gradients and beaver dams may help reduce competition between harlequin ducks and fish, but this is still speculative.

In Glacier National Park, adjacent to the Forest, there is natural variability in amount or timing of stream flows, and harlequin duck nesting success is also known to be variable. Future changes in climate may magnify this effect on all lands. There has likely always been stream flow variability, but the intensity and timing of future climte effects on harlequin ducks is uncertain. Hansen speculated that climate changes will likely enhance the prevalence of severe stream flow factors that limit harlequin reproductive success. Peak runoff is expected to occur earlier in the spring, potentially reducing foraging efficiency in females preparing to lay eggs and delaying egg laying until nest sites become available. In addition, the timing of spikes in stream flow may cause flooding of established nests. The potential combination of earlier spring snowmelt, less snow pack (at least at lower elevations), and lower late summer flows associated with more frequent or extreme summer drought could reduce water quality and quantity in the late nesting season. This could also affect harlequins because backwaters important for brood rearing may be dried up by August, although known brood-rearing streams on the Forest are on the larger rivers (e.g. North Fork and South Forks of the Flathead River) where this effect is less likely. Climate changes could also have negative effects on the aquatic insects that harlequin ducks feed upon, since these insects require cold water with high levels of oxygen (Hansen 2014). Multiple agencies monitor harlequin ducks, contributing to our ability to manage adaptaptively.

Effects of hunting and environmental contamination on the Pacific Coast waters where harlequin ducks winter is uncertain, but is being studied.

In summary, the cumulative effects of the proposed forest plan alternatives, in the context of all lands of the larger landscape, would contribute to the ecological integrity of aquatic, wetland, and riparian wildlife habitats that support harlequin ducks. This would be accomplished by a forestwide plan component to limit the risk of disturbance on known nesting stream reaches, as well as forestwide plan components for riparian management zones and watersheds. Streams with historic and current observations of harlequin ducks and habitat conditions that support harlequin ducks are distributed across all but the Swan and Salish GAs. While the Forest does not have authority over all stressors that may affect harlequin ducks (such as hunting or chemical contaminants in wintering habitat), the Forest contributes to the ecological conditions that support them.

Northern Bog Lemming

Key indicators for analysis

The public expressed an interest in this species during scoping. In addition to the indicators and effects of alternatives described under “Wildlife associated with aquatic, wetland and riparian habitats”, the following species-specific indicator applies to northern bog lemmings:

- Plan components to support key ecosystem characteristics of wetlands

Affected Environment

Northern bog lemming population, life history, habitat, and distribution

The northern bog lemming is known to occur in northwest Montana, with a Montana range that extends east to the Rocky Mountain Front and south through the Lost Trail Pass to the Continental Divide (Reichel and Corn 2007), as well as much of Canada and Alaska. The total number of known bog lemming sites in Montana was listed as 18 in 1997 (Riechel and Corn 1997). There are currently 22 locations where northern bog lemmings have been documented (Turnock and Anderson 2012). The majority of sites are in Glacier National Park, with additional sites on 6 national forests in northwest Montana (including two national forests adjacent to the Forest). Northern bog lemmings are a mouse-sized small mammal with a high reproductive rate. The population and trend for bog lemmings is unknown because they are very difficult to detect without a trapping effort to and many potential sites have not had a trapping effort (Turnock and Anderson 2012). New methods are being tested that may make it easier to detect bog lemmings in the future.

Key characteristics of habitat for bog lemmings in Montana are associated with bogs, peatlands, and a subset of peatlands known as fens, but they have been detected in at least 9 other habitat types including riparian habitats with Engelmann spruce, subalpine fir, birch, willow, sedge (Carex), spike rush (Eleocharis), or combinations of the above. The Forest does not have bogs, but other wetlands and riparian habitats are abundant (see wildlife section above and 3.2.10 for more details). Wetlands that may contain peat total about 700 acres in about 290 different sites, ranging in size from <1–84 acres. They occur in all GAs, with the highest number of acres in the South Fork Flathead River GA (including wilderness) and the lowest number of acres in the Middle Fork GA.

While bog lemmings are found in diverse wetland and riparian habitats, large mats of sphagnum moss (associated with peatlands) have been found to be the best indicator that northern bog lemmings are present (Reichel and Beckstrom 1994) and are the most likely sites to find new populations (Reichel and Corn 1997). Known bog lemming habitat patches across Montana range from 1-340 acres in size and from 3340 ft. elevation at McDonald Creek in Glacier National Park to 6520 at Maybee Meadows on the Beaverhead-Deerlodge National Forest. In low-gradient landscapes, beavers may affect potential bog lemming habitat by creating ponds that go through succession to become dominated by sedges and peat (Chadde et al. 1998).

Very little of habitat on the Forest has had bog lemming surveys (Reichel and Corn 1997, Turnock and Anderson 2012). Bog lemmings have been confirmed by trapping at two sites on the Forest, one in the Bowen Creek area of the Salish Mountains GA and one in the Lindberg Lake area of the Swan Valley GA. Northern bog lemming observations have also been reported at the Sanko Creek Fen in the Salish Mountains GA and in the Meadow Creek Fen in the Swan Valley GA, but these observations have not been confirmed. Northern bog lemming observations have also been reported at the Sanko Creek Fen in the Salish Mountains GA and in the Meadow Creek Fen in the Swan Valley GA, but these observations have not been confirmed.

The affected environment section describes key ecosystem characteristics associated with a species. The key stressors section which follows provides a foundation for the alternative effects analysis and an understanding of which stressors the USFS has authority to manage. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are activities that might impact a species and its habitat if not managed or mitigated. Stressors that are outside of Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. These are considered under “Cumulative Consequences”.

Key stressors under USFS control

Land Management: Activities that can affect these habitats include activities that change peatland hydrology such as clearcutting, cattle grazing, or road building. Clearcutting and stand-replacing wildfire in areas next to peatlands may increase populations of species that compete with northern bog lemmings (http://fieldguide.mt.gov obtained 2014).

Key stressors not under USFS control

Climate Change: The effects of climate change on peatlands are unknown, but climate has varied widely over the past thousand years during which current peatlands were forming. Peatlands have high water-holding capacity which helps their resilience to periods of drought (Chadde et al. 1998).

Peat mining, dredging or filling of peatlands: Peatlands are classified as wetlands so these activities require permits under the authority of other agencies.

Land Management: Activities that can affect these habitats include activities on non-NFS lands that change peatland hydrology such as clearcutting, cattle grazing, or road building. Clearcutting and wildfire, can also increase populations of species that compete with northern bog lemmings (http://fieldguide.mt.gov obtained 2014).

Summary of alternative consequences

Key ecosystem characteristics described in the affected environment section would be supported by plan components for watersheds, peatlands and fens, and riparian ares (also see wildlife section above and sections 3.2.10 and 3.5 of DEIS Chapter 3). With all alternatives, clearcutting is not allowed in RHCAs or RMZs. With all alternatives, road access requirements help to reduce the risks to bog lemming habitat that could occur due to changes in hydrology of peatlands and other wetlands.

Environmental consequences alternative A

The 1986 forest plan has standards and guidelines for timber, roads, grazing, recreation, minerals, and fire management that promote bog lemming habitat in RHCAs. The RHCA width around wetlands greater than an acre in size is 150 feet while the RHCA width around wetlands less than an acre in size is 50-100’. Because grazing is not widespread across the forest, it would continue to have a minimal effect on watersheds as a whole, however, localized impacts to potential bog lemming habitat may occur unless areas are fenced, as specified in a site-specific allotment management plan.

Environmental consequences alternatives B, C, and D

Key habitat characteristics described in the affected environment (e.g. wetlands including peatlands and fens with large mats of sphagnum moss) would be supported by forestwide plan components for watersheds, RMZs, and management areas (MAs) included in all action alternatives. In addition, with alternatives B, C, and D, standard FW-STD-RMZ-01 supports connectivity of small wetlands because the riparian management zone (RMZ) around mapped wetlands across the forest (including peatlands) would be increased to a distance of 300 feet, which is greater than the 50-100 foot distance under alternative A. This increased distance, in combination with desired conditions FW-DC-WTR-17, FW-DC-RMZ-07, 08 and standards FW-DC-WL SOI-01 and FW-STD-RMZ-03 and 04, support the ecological integrity of wetlands (including peatlands/fens), supporting the habitat of bog lemmings and its connectivity.

Standards FW-STD-GR-07 and 08 protect bog lemming habitat by requiring that new livestock handling and/or management facilities will be located outside of RMZs and grazing practices (e.g., accessibility of riparian areas to livestock, length of grazing season, stocking levels, timing of grazing, etc.) that adversely affect fish and riparian habitat will be modified.

Compared to the no action alternative, the action alternatives also provide more protection of key ecosystem characteristics by designating 8 more peatlands/fens as MA3b (figures B-50-52), where peatland protections would be even more extensive. MA3b-Special area-SUIT-01 and 02 state that special areas are not suitable for timber production or commercial use of non-timber forest products. Vegetation management activities (such as prescribed fire) may be allowed for reasons specifically designed to maintain the values and desired conditions associated with the special area. MA3b-Special area-SUIT-03 states that the fens, and Glacier Slough and Johnson Terrace special areas are not suitable for new trail construction, new wheeled motorized trails and areas, and associated structures. Existing trails that access these areas are suitable (also see section 3.5).

Cumulative consequences

In the past, peatland hydrology may have been affected on all lands by cattle grazing, adjacent road building, dredging, filling, timber harvest, or fire suppression. Fire suppression may increase cover, but can also increase the risk of high severity fires near peatland habitat, especially if summers become hotter and drier in the future. In the last few decades, federal and statewide watershed, wetland, and riparian management direction, as well as local management direction, has provided protections on all lands (see sections 3.2.10, 3.5. and cumulative effects on aquatic, wetland and riparian habitats above for more details).

How the natural range of variation in the past has affected peatlands/fens is unknown. Small peatlands may occur in naturally small and isolated patches, making them vulnerable to loss due to changes in groundwater. Larger peatlands with deeper water are not as vulnerable. Peat accumulates very slowly, typically occurring at rate of 8-11 inches in 1,000 years. Constant high water levels lead to accumulation of organic matter which is usually greater than 15 inches deep. As summarized by Gage and Cooper (2013), “Stable hydrologic regimes are necessary for peat accumulation, and a water table decline will, over time, result in peat oxidization. Because fens vary widely in geomorphic setting and hydrologic functioning, and few long-term hydrologic data are available for different fen types, it is difficult to generalize about the likely response of fens to past climatic fluctuations. The historic range of variability (HRV) for key climatic factors important to fen hydrologic regimes and carbon accumulation dynamics is unknown. The range of these factors (such as the amount and seasonality of precipitation, timing of spring snowmelt, and temperature) is broad and includes extended periods of both wet and cool conditions and extended dry periods”. Existing peatlands are believed to have been formed over a time period of a thousand years, with extended dry periods and other climatic fluctuations in the past, and they have persisted. It is likely that they will persist in the future, although the smallest areas may go through more extended periods without water.

In summary, the cumulative effects of proposed management actions on the Forest, in the context of all lands of the larger landscape, contribute to the ecological integrity of aquatic, wetland, and riparian wildlife habitats that support bog lemmings. This would be accomplished by forestwide plan components for riparian management zones and watersheds. Potential bog lemming habitat is distributed across all Forest GAs. While the Forest does not have authority over all stressors that may affect bog lemmings, the Forest contributes to the ecological conditons that support them.

Common Loon

Key indicators for Analysis

The public expressed an interest in this species during scoping. In addition to the indicators and effects of alternatives described under “wildlife associated with aquatic, wetland and riparian habitats” and “soils, watersheds, riparian areas, and aquatic species”, the following species-specific indicator applies to common loons:

- Plan components to support key ecosystem characteristics of loon territorial nesting lakes, including minimizing the risk of human disturbance to nesting loons.

Affected environment

Population, life history, habitat, and distribution

The breeding range of the common loon is distributed across most of Canada and Alaska. Northwestern Montana is at the southern edge of the common loon breeding range and the Montana population migrates primarily to the west coast for winter. Data collected between 1999 and 2006 indicated the number of occupied breeding territories consistently averaged between 50 and 70 (MFWP, unpublished data) with no increase in the number of new territories, suggesting that Montana's population may be stable (Hammond et al. 2012). The number of territorial pairs in Montana has increased by 44% from 2006-2014 and chick production has also increased (Byrd et. al. 2015).

Three of Montana's four areas of highest loon breeding densities are with the Flathead National Forest (also including other land ownerships). On the Forest, there are about 25 known breeding pairs on nesting lakes in the Hungry Horse, Middle Fork, North Fork, Salish Mountain, and Swan Valley Geographic Areas (MNHP data 2013). In addition to approximately 50 lakes with known or potential nesting habitat, there are many more lakes used by loons for feeding within the Forest. About half of the lakes with breeding pairs have shoreline on NFS lands.

Availability of nesting lakes in a complex with additional feeding habitat is a key ecosystem characteristic. Common loons nest and feed on lakes of suitable size and elevation. In northwest Montana, the highest common loon nest success was observed on lakes greater than 13 but less than 60 acres in size (MT-CLWG 2010). In northwest Montana, lakes less than 5000 feet elevation generally have a long enough ice-free season to accommodate loon nesting (Hammond 2009). Not only are lake-scale habitat factors important to loon management, but so are landscape scale factors, especially complexes of lakes that provide for feeding near nesting lakes. Hammond and others (2012) expressed a need to protect occupied territories and prioritize conservation efforts for lake complexes that have high numbers of territorial pairs. These territories are likely to remain occupied over time and to provide the population growth necessary for occupancy of surrounding unoccupied habitat.

Nest success may decrease when loons are exposed to disturbance (Vermeer 1973, Kelly 1992; *IN* Hammond et al. 2012), but some loons appear to tolerate disturbance (Titus and VanDruff 1981 *IN* Hammond et al. 2012) Because loons may spend more time off their shoreline nests if disturbed, eggs are more vulnerable to predators (Christenson 1981 *IN* Hammond et al. 2012). In addition, recruitment may decline over time as loons are less likely to return to territories experiencing excessive disturbance, and therefore must either compete for territories occupied by other pairs or establish new ones on unoccupied lakes (Vermeer 1973 *IN* Hammond et al. 2012).

The affected environment describes key ecosystem characteristics associated with a species. The key stressors section which follows provides a foundation for the alternative effects analysis and an understanding of which stressors the USFS has authority to manage. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are activities that might impact a species and its habitat if not managed or mitigated. Stressors that are outside of Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. These are considered under "Cumulative Consequences".

Key stressors under USFS control

Land Management: The USFS has authority over management activities along shorelines used for nesting on NFS lands, including shore-based disturbance resulting from recreational use (e.g. shoreline trails, dispersed and developed camping, picnic sites, boat launch access); disturbance from vegetation management or road construction near lake shorelines; or loss of protective vegetation at the nest site or between sources of shoreline disturbance and nursery areas.

Key Stressors NOT under USFS control

Water-based recreation on nesting lakes: Human disturbance can cause nesting loons to be flushed from nest for prolonged periods of time, leading to loss of eggs due to cooling or predation. Boat wakes can flood and flush eggs from nests. The Forest does not have authority over recreational use on lakes or other land ownerships. The state has authority over recreational activities such as fishing, boating, and wake limits on recreational lakes.

Contaminants: High lead and/or mercury levels in feeding lakes or lake sediments can impact loons (Savoy 2004). Chemicals used to kill undesirable fish species may indirectly affect loons by reducing their food sources, at least in the short-term.

Climate and weather: Evers and others (2014) hypothesized that potential climate change effects on loons are: 1) changes in air and water temperature that can affect the production, abundance, and distribution of aquatic organisms that provide food for the Common loon, either directly or indirectly; 2) prolonged drought that could alter the depth of water, flow of water, and water-borne nutrients in a lake and 3) changes in water chemistry. The historic range of variability for these factors is unknown, but common loons nest on large lakes which tend to be stable.

Stressors associated with migration and while in wintering habitat: Common loons are vulnerable to predation and to chemical contamination of their coastal wintering habitat (e.g. oil spills, lead or mercury contamination)(Evers et al. 2014).

Summary of Alternative Consequences

Plan components would support key ecosystem characteristics described in the affected environment section. Hammond et al. (2012) stated that Montana’s loon population was in a state of equilibrium, and that management for stable or growing loon populations could be achieved using long-term monitoring and protection of loons on occupied territorial nesting lakes and nearby feeding lakes. The Forest has been helping to protect nesting loons for decades and would continue to do so under plan direction for all alternatives.

Environmental Consequences Alternative A

RHCA management direction has supported most key ecosystem characteristic for common loons because it provides protection for riparian habitat areas within 150 feet of lakes where loons nest and feed. However, RHCA direction does not address human disturbance at loon nesting lakes.

Environmental Consequences Alternatives B, C, and D

Key ecosystem characteristics described in the affected environment would be supported by implementation of coarse filter plan components for watersheds and RMZs included in all action alternatives that reduce the risk of cover loss and manage road access near nesting lakes. In addition, species-specific plan components included in all action alternatives would reduce the risk of human disturbance to nesting loons. Guideline FW-GDL-WL SOI-03 adopts specific guidelines to reduce disturbance of loons at Code A territorial nesting lakes (current or recent nesting) (see appendix A of the

Conservation Plan for the Common Loon in Montana 2010 or subsequent MFWP updates if applicable). FW-GDL-WL SOI-03 reduces the risk of disturbance to nesting loons by specifying that measures should be implemented to avoid or mitigate adverse impacts to their nesting habitat during Mid-April to Mid-August (also see appendix C). Objective FW-OBJ-WL SOI-01 specifies that the USFS would install structures such as floating signs or nesting platforms to promote successful common loon reproduction on 3-10 lakes annually, as needed. Campgrounds and boat ramps that facilitate access to lakes with nesting loons can contribute to disturbance as well. Grizzly bear standard FW-STD-REC-01 limits increases in the number and capacity of developed recreation sites, which would also reduce the risk of disturbance of nesting loons.

Cumulative Consequences

In the past, disturbance is thought to have depressed loon populations. Common loon populations on the Forest and adjacent lands managed by other landowners have rebounded from the lows of the 1980’s due to more than 3 decades of coordinated effort by multiple agencies, private organizations, and private landowners. These efforts have included educating recreationists about the sensitivity of loons to disturbance while nesting and raising chicks, the negative effects of contaminants such as lead, and the importance of maintaining diverse, abundant populations of fish in nesting lakes. Efforts have also included placing floating signs around active nests and/or placing floating nesting platforms on lakes with high levels of water fluctuation or strong boat wakes. In the future, given expected increases in the number of recreational users and development of private shorelines, these efforts are anticipated to continue.

Effects of environmental contaminants on loons (e.g. mercury) associated with the Pacific Coast environment where loons winter is being monitored (Byrd et al. 2014).

Habitats preferred by the common loon in northwest Montana are also expected to continue to change as a result of human land uses on all lands, particularly in the developed valley bottoms where many nesting lakes are located. Private land development on shorelines and increasing recreation use on some lakes may limit nesting habitat or increase disturbance. Lakes tend to be popular recreation destinations, so on lakes with mixed ownerships, disturbance to nesting loons by boats or approaching too close will be likely. Some lakes that have nesting loons are adjacent to private lands and most disturbances are likely to come from the private lands/residences. Continued coordination and mitigation of these effects will be necessary.

In the future, some climate change predictions include more frequent storms and greater fluctuations in water levels (see climate discussion in the Forest Assessment 2014). Because loon anatomy makes it difficult for them to walk on land, their nests are often very close to lake or island shorelines. Increasing water levels, more frequent storms, or more wave action may destroy nests during the time period when adults are incubating. Some, but not all loons, may re-nest. Because the probability of these risks actually occurring is based upon a variety of factors (e.g. lake-basin configuration) the level of risk is not currently known, but loon nesting success is monitored by multiple partners and will support adaptive management.

In summary, the cumulative effects of proposed management actions on the Forest, in the context of all lands of the larger landscape, contribute to the ecological integrity of aquatic and riparian wildlife habitats that support loons. This would be accomplished by forestwide plan components for riparian management zones and watersheds as well as forestwide plan components to reduce the risk of disturbance to nesting birds. Loon nesting and feeding habitat is distributed across all but the Middle Fork Flathead River GA. While the Forest does not have authority over all stressors that may affect loons, the Forest contributes to the ecological conditons that support them.

Beaver

Key indicators for Analysis

The USFS can provide habitat that supports beavers by providing for biodiversity, which includes the deciduous trees and shrubs they feed upon and use for dam building. In addition to the indicators and effects of alternatives described under section 3.2.10, "wildlife associated with aquatic, wetland and riparian habitats" and "wildlife associated with hardwood trees", the following species-specific indicator applies to beavers:

- Plan components to reduce the risk of loss of beaver dams.

Affected environment

Population, life history, habitat, and distribution

Beavers are distributed across most of North America and are year-round residents across Montana. Beavers are considered to be ecological engineers that create habitat for many other species so they play an important role in helping to sustain biodiversity. Much of the woody vegetation cut by beavers is used for building dams and lodges. Beavers eat a variety of shrubs and hardwood trees including willows, mountain alder, aspen and cottonwood which they cache near shore for winter food. They also eat herbaceous vegetation during summer.

Beaver prefer to build dams on small- to medium-sized, low-gradient streams (<6% slope) that flow through unconfined valleys, and generally populate the lowest gradient (slope < 1-2%) sites first (Francis et al. 1985). Beaver also build dams on lakes, wetlands, culverts or just about any place where additional water can be retained. They generally avoid constrained valleys with high-gradient streams but will colonize this less-preferred habitat if their population densities are high. Water impoundments built by beavers elevate the water table, expand the saturated surface area of riparian zones, and can convert upland plant communities into wetland plant communities or expand the area of wetlands. Beaver ponds can also trap sediment and increase productivity of streams by increasing the availability of organic nutrients (Francis et al. 1985) and by allowing sunlight to reach more water surface for photosynthesis. Because beaver impoundments can slow the flow of a stream, they hold the water within the stream reach for longer periods and can increase base flows as well as warming the temperature.

The number of beaver dams on Forest lands is unknown, but they are widespread across the Flathead Valley (Newlon and Burns 2010). Beaver dams have been removed when they create conflicts with human infrastructure, but this tends to be a short term solution, as new beavers will often re-occupy a site within 1-2 years. Alternative methods can be used to reduce the impacts of dams without removing them (Pollock et. al. 2015).

The affected environment describes key ecosystem characteristics associated with a species. The key stressors section which follows provides a foundation for the alternative effects analysis and an understanding of which stressors the USFS has authority to manage. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are activities that might impact a species and its habitat if not managed or mitigated. Stressors that are outside of Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. These are considered under "Cumulative Consequences".

Key Stressors under USFS control

Human removal of beaver dams: Because beaver have been a real or perceived threat to infrastructure or cold water fish species, beaver dams on NFS lands (and other ownerships) have been removed in places to: 1) remove channel blockage for spawning bull trout, 2) prevent flooding that can undermine features such as road beds, or 3) keep culverts from being plugged and serving their water drainage function.

Key Stressors not under USFS control

Climate change: Climate change is not believed to be a substantial stressor for beavers in northwest Montana, rather, beavers may increase habitat resilience to climate change.

Trapping: When beavers threaten infrastructure on private lands they are often trapped and removed. Montana Fish, Wildlife and Parks classifies the beaver as a furbearer and it can be legally trapped with a license or damage permit.

Summary of Alternative Consequences

With all alternatives, plan components for RHCAs or RMZs would support support key ecosystem characteristics for beavers and the wetland habitats they create for many other animal and plant species. The action alternatives B, C, and D provide additional species-specific plan components to help sustain beavers if their dams create conflicts with human infrastructure.

Environmental Consequences Alternative A

Alternative A does not have plan components that support presence of beaver dams. RHCAs and associated management direction protects wetlands and streams across the forest.

Environmental Consequences Alternatives B, C, D

Plan components for aquatic, wetland and riparian ecosystems and key ecosystem characteristics would improve habitat diversity for beavers and for the other species associated with the wetlands created by beaver dams. In addition, species-specific plan components would promote retention of beaver dams. Desired condition FW-DC-WTR-16 supports the important ecological role that beavers play in creating and maintaining wetlands. FW-GDL-WTR-08 states that when beaver dams are threatening human infrastructure or bull trout passage, preferred techniques that sustain beavers (e.g. using pipes to reduce water levels, notching dams to restore streamflow) should be used prior to using more drastic measures (e.g. removing beavers or removing their dams).

Cumulative Consequences

Private landowners are likely to continue to remove beaver dams and/or trap beavers if they flood roads or property. Beaver pelt prices determine their popularity for recreational trapping and MFWP regulates trapping to sustain beaver populations. Beavers may be trapped to reduce damage to infrastructure. Glacier National Park, encompassing about a million acres adjacent to the Forest, is closed to trapping. Beavers play a role in creating wetlands in Glacier National Park and the CSKT Flathead Reservation adjacent to the Forest.

Maintaining beaver across the landscape may help to make aquatic ecosystems resilient in the face of anticipated future climates, benefiting many other aquatic, wetland, and riparian wildlife species in the future. Water storage from beaver impoundments may support sustainability of wetlands and riparian habitats by capturing runoff. As water storage in the form of glaciers and snow decreases, surface and groundwater storage behind beaver dams may provide a buffer for base flows (Beechie et al. 2013).

Larger and higher severity wildfires associated with climate change may initially reduce availability of food and dam-building materials for beavers, impairing their ability to survive the first few winters after fire. As time goes on, shrubs and deciduous trees would regenerate in burned areas and increase forage and building materials for dams.

In summary, the cumulative effects of proposed management actions on the Forest, in the context of all lands of the larger landscape, contribute to the ecological integrity of aquatic and riparian wildlife habitats that support beavers. This would be accomplished by forestwide plan components for riparian management zones and watersheds as well as forestwide plan components to reduce the risk of beaver dam removal. Beaver habitat is distributed across all Forest GAs. While the Forest does not have authority over all stressors that may affect beavers, the Forest contributes to the ecological conditons that support them.

Boreal (western) toad

Key indicators for Analysis

The public expressed an interest in this species during scoping. In addition to the indicators and effects of alternatives described under section 3.2.10, “wildlife associated with aquatic, wetland and riparian habitats”, “Vegetation”, and “Invasive Species,” the following species-specific indicator applies to the boreal toad:

- Plan components to promote key ecosystem characteristics of boreal toad habitat, including minimizing the risk of: 1) the spread of aquatic invasive species in ponds and wetlands used for breeding.

Affected environment

Population, life history, habitat, and distribution

The range of the boreal toad extends from Alaska south to Mexico, across the western U.S. and across western Montana. Maxell (2000) conducted a systematic survey of standing water bodies in 40 randomly chosen 6th code HUC watersheds across western Montana. Boreal toads were found in 27% of the watersheds, with breeding documented in 21%. At sites where toads were observed, only small numbers of adults and relatively small numbers of eggs or larvae were observed. In Glacier National Park, adjacent to the Forest, surveys conducted in 1999-2000 detected breeding boreal toads in 5% of the watersheds surveyed. Maxell’s conclusion was that toads were recovering since a decline in the 1980’s or were continuing to decline because populations were small, isolated, and/or subject to one or more factors impacting populations separately or synergistically, as had been known to occur in Colorado, Utah, Wyoming, and New Mexico (Maxell 2000). However, a subsequent study of boreal toads in Glacier National Park found that they dramatically increased in numbers after fires in 2001 and 2003 (Guscio et al. 2007).

Similarly, there were extensive wildfires in the North Fork Flathead River, South Fork Flathead River, Swan Valley, and Hungry Horse GAs of the Forest in 2003. Extensive monitoring has occurred on the Forest during 15 years of annual citizen-science “Herp Days” surveys. Across the Flathead National Forest, juvenile or adult boreal toads have been observed in 31 of the 65 sub-watersheds (6th-code HUCs)(planning record exhibit V-6). In the last ten years, the Montana Natural Heritage Program database has 62 records of this species on the Forest, including an estimated 58,000 juveniles and immature toads from about 27 sites. While boreal toads may be in decline in the more arid grazing lands east of the continental divide, boreal toads have been monitored for close to 15 years on the Forest and there is no evidence of a decline in distribution.

Boreal toads breed in a wide variety of aquatic habitats including low elevation beaver ponds, reservoirs, streams, marshes, lake shores, potholes, wet meadows, ditches and marshes, to high elevation ponds, fens, and tarns at or near treeline. They exhibit a preference for shallow, warm areas with mud or silt bottoms (Maxell 2000). Breeding sites used by toads can undergo a high level of fluctuation in water levels from year to year due to drought, natural variation in groundwater and runoff levels, as well as through changes in water yield and water temperature caused by tree harvest and wildfires. Small breeding ponds created by seeps may dry out in some years before metamorphosis occurs, killing tadpoles and rendering reproduction entirely unsuccessful at that site for the year (Maxell 2000). After breeding, adult toads disperse into surrounding terrestrial habitats. Toads can remain away from surface water for relatively long periods of time. Although they inhabit a variety of both wet and dry upland habitats, adult boreal toads are largely terrestrial and may move more than a mile away from water after the breeding season is finished (MFWP-MNHP 2015).

Juveniles are often present in wetlands adjacent to breeding sites, and may overwinter along the borders of sites where they were born (Nussbaum et al. 1983). Adult and juvenile western toads dig burrows in loose soil, use burrows of small mammals, or occupy shallow shelters under logs or rocks. At least some toads overwinter in terrestrial burrows or cavities where conditions prevent freezing (MFWP 2015).

The Forest has over 45,000 acres of modelled breeding habitat and the boreal (western) toad is known to use a wide variety of sites for breeding (see Forest Assessment, 2014, for more details). Although small wetlands and small water bodies on the Flathead may go through large fluctuations in water levels from year to year, and may even dry up during some years as a result of drought, boreal toads are highly mobile and monitoring has shown that they appear to re-occupy sites during years when water levels become suitable. Boreal toads are distributed across abundant aquatic, wetland, and riparian habitats in all Forest geographic areas and do not appear to be experiencing low numbers, isolated populations, or declines observed in some other areas. Based upon finding by Gusico in areas adjacent to the Forest, increases in wildfires on the Forest in recent decades have improved habitat for boreal (western) toads.

Guscio (2007) found toads that bred in the Robert burn in the spring of 2003 were found exclusively in burned habitats during the summer months and found that toads used high severity burn areas much more than would be expected. Severely burned areas were more open, but toads could use burned areas without great risk of increased water loss as long as they had cover provided by downed logs, etc. They also found that boreal toads shifted their use away from severely burned habitats to moderately burned areas later in the summer, because partially burned areas had more ground/canopy cover and likely retained more soil moisture (Guscio et al. 2008). In an Oregon study, Bull found that boreal toads used sites with tree harvest or prescribed burn activities in proportion to their availability and were not avoided by boreal toads (Bull 2006). Areas with no trees, or with tree seedlings, were used more than expected based on availability, while older stands were used less.

Timber harvest and wildfire can affect boreal toads by changing vegetative cover, which can indirectly affect the water level and temperature in breeding sites. Since boreal toads prefer warm water, this is generally not a negative factor for the cold waters of the Forest. Boreal toads may congregate around roads in the late evening and early morning, making them vulnerable to being run over by vehicles (Maxell 2000).

Cattle grazing may be a stressor for boreal toads, but is a very minor factor on the Forest because it is predominantly a forested environment, whereas habitat east of the continental divide in Montana is predominantly a grassland environment. Since 1986 more than half of the cattle allotments on the Forest have been vacated and closed. As of 2014, the Flathead National Forest had nine active grazing allotments in two geographic areas; Swan Valley and Salish Mountains (see grazing section of chapter 3 for more details). Toxins in the water or sprayed within about 330 feet of water bodies can be lethal during certain stages of the toad life cycle (Maxell 2000). The Forest does not use toxins within about 330 feet of water bodies.

The affected environment describes key ecosystem characteristics associated with a species. The key stressors section which follows provides a foundation for the alternative effects analysis and an understanding of which stressors the USFS has authority to manage. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are activities that might impact a species and its habitat if not managed or mitigated. Stressors that are outside of Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. These are considered under "Cumulative Consequences".

Key Stressors under USFS control

Invasive species: Die-offs of boreal toads in the Southern Rockies have been associated with chytrid fungus (*Batrachochytrium dendrobatidis*) infections (Daszak et al. 2000). Limb deformities in toads have been linked directly to trematode infections by *Ribeiroia ondatrae* (Johnson et al 2002). Chytrid fungus *(Batrochytrium dendrobatidis)* is present in a variety of amphibians in Montana and deformities in toads have been observed in some areas (Maxell et al 2004). Chytrid fungus is not yet known to be present on the Forest, nor have any deformities been observed. Invasion of breeding sites by non-native bullfrogs, which feed on boreal toad eggs and tadpoles, has occurred at one location in the Salish GA (MNHP unpublished data 2013). Invasion of small, shallow breeding ponds by Reed canarygrass (*Phalaris arundinacea*) has occurred in portions of the Swan Valley and can cause breeding ponds to dry out.

Key Stressors not under USFS Control

Invasive species: The USFS cannot control spread of invasive species on non-NFS lands.

Mortality on highways: Boreal toads may be run over when they move from breeding habitats to non-breeding habitats, especially on high-speed roads that are travelled at night.

Toxins: Use of certain herbicides or pesticides on private lands within about 330 feet of streams or other water bodies used by toads can also be lethal during certain stages of the toad life cycle and may occur on private lands (Maxell 2000).

Climate change: Increased incidence of drought associated with climate change could have a negative effect on boreal (western) toads if it causes breeding ponds to dry up before immature toads are able to survive out of water. Because the Forest has widespread, diverse water bodies of a wide range of sizes that are used by boreal toads for breeding, the impacts of climate change are expected to be relatively low. Increases in wildfires are expected to have a neutral or positive effect.

Summary of alternative consequences

With all alternatives, plan components for RHCAs or RMZs would support support key ecosystem characteristics for boreal toads.

Environmental consequences alternative A

RHCA management direction has supported most key ecosystem characteristic for boreal toads because it provides protection for riparian habitat within 150 feet of ponds, lakes, and wetlands greater than an acre in size and within 50-100 feet of wetlands less than an acre in size, where boreal toads breed. RHCA management direction also limits new roads in RHCAs. Alternative A does not have specific management direction to address aquatic invasive species.

Environmental consequences alternatives B, C, and D

With alternatives B, C, and D, standard FW-STD-RMZ-01 supports key ecosystem characteristics for boreal toads because the riparian management zone (RMZ) around mapped wetlands across the forest would be increased to a distance of 300 feet. Plan components for invasive species and roads included in all action alternatives would reduce the risk of spread of aquatic invasive species and reduce the risk of mortality due to roads. Desired condition FW-DC-AQS-03 states that aquatic ecosystems are free of invasive species such as zebra mussels, New Zealand mud snails, quagga mussels, and Eurasian milfoil. Non-native plant and amphibian species are not expanding into water bodies that support native amphibian breeding sites (e.g., non-native bullfrogs, Chytrid fungus, or Reed canary grass are not expanding into boreal toad breeding sites). Guideline FW-GDL-AQS-02: states that equipment that may spread aquatic invasive species should be inspected and cleaned in order to promote successful breeding by boreal toads and other amphibians. Guidelines FW-GDL-AQS- 04 and 05 state that educational informational programs and materials should address aquatic invasive species, including preventive measures at water-based recreation sites. Guideline FW-GDL-RMZ-02 also states that water drafting equipment, water tenders and helicopter buckets should be inspected and cleaned for aquatic invasive species prior to use in a water body. Guideline FW-GDL-NNIP-01 states that non-native invasive plant treatments within RMZs should consider use of mechanical, biological, and cultural means of control before chemical control methods and objective FW-OBJ-NNIP-01 provides direction to treat 12,000 to 16,000 acres over the expected 15 year life of the plan to contain or reduce non-native invasive plant density, infestation area, and/or occurrence.

Cumulative Consequences

Boreal (western) toads are cumulatively affected by activities occurring in waters where they breed, as well as on land. Monitoring has shown the invasive plant, Reed canarygrass, occupies some boreal toad breeding sites in areas of intermingled public and private lands, such as the Swan Valley. In recent years the Forest has implemented projects to reduce invasion of reed canarygrass in wetlands of the Swan Valley geographic area.

On all lands, livestock grazing in shallow breeding ponds may remove emergent vegetation used by larvae, and trampling by livestock may crush tadpoles. However, livestock grazing is a very minor activity on most of the Forest, so unlike some adjacent national forests, livestock grazing has minor effects on the Forest.

Although diseases and parasites are not yet known to be a factor on the Forest, die-offs of boreal toads have occurred in the Southern Rockies and may occur in the northern Rockies (including the Forest) in the future. These die-offs have been associated with chytrid fungus (*Batrachochytrium dendrobatidis*) infections. Other pathogens which may affect boreal toads include the fungus *Saprolegnia ferax* or the trematode *Ribeiroia ondatrae* (Johnson et al 2002). Pathogens may be spread by the actions of others.

Past timber harvest created open habitats that are favored by boreal toads provided down woody material is retained in harvest units. Down woody material retained on national forest system and state lands is beneficial by providing cover. An increase in wildfire and use of prescribed fire in recent decades has been beneficial to the boreal (western) toad for the same reasons.

Roadside ditch breeding sites are vulnerable to seasonal dry-up and impacts from activities such as road grading and maintenance. This impact is most likely to occur on private lands. On NFS lands, these effects appear to be very small, because many forest roads are closed and <14% of all forest roads per year receive maintenance that may affect toad breeding sites. Traffic levels on most forest roads are low during the toad breeding season and most forest roads do not have high-speed use like highways, reducing the risk of mortality. In addition, FW-STD-IFS-01 thru 05 and guidelines FW-GDL-IFS-02 thru 04 for roads in grizzly bear habitat would reduce the risk of mortality of boreal toads.

In summary, the cumulative effects of proposed management actions on the Forest, in the context of all lands of the larger landscape, contribute to the ecological integrity of aquatic and riparian wildlife habitats that support boreal (western) toads. This would be accomplished by forestwide plan components for wetlands, riparian management zones, and watersheds as well as forestwide plan components to reduce the risk of spread of aquatic invasive species. Boreal toad habitat is distributed across all Forest GAs. While the Forest does not have authority over all stressors that may affect boreal toads, the Forest contributes to the ecological conditons that support them.

Bald eagle

Key indicators for analysis

The public expressed an interest in this species during scoping. In addition to the indicators and effects of alternatives described under 3.2.10, “wildlife associated with aquatic, wetland and riparian habitats”, and “Vegetation” (including old growth and very large snags), the following indicators apply to the bald eagle.

- Plan components to promote key ecosystem characteristics for the bald eagle, including very large trees and snags for nesting and roosting within ½ mile of large rivers and lakes and minimizing the risk of human disturbance to eagles at active nest sites.

Affected environment

Population, life history, habitat, and distribution: The bald eagle is distributed across most of North America and across Montana. The bald eagle was removed from the federal list of threatened and endangered species in 2007, but continues to be protected by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Bald eagle population biology, ecology, habitat description and relationships identified by research are described in the Pacific Bald Eagle Recovery Plan (USFWS 1986) and the Montana Bald Eagle Management Plan (MFWP 1994, Hammond 2010). Formal surveys for nesting bald eagles, including those on the Forest, are conducted by Montana Fish, Wildlife, and Parks in cooperation with the USFS and other state, federal, and volunteer partners.

The Forest is in Montana’s Zone 7 (MFWP 1994). In 2010, 180 of the 242 known nests in Zone 7 were checked, revealing 77% nesting success with 190 eaglets produced. The population continues to increase and nesting birds are starting to occupy areas that were previously considered to be marginal habitat at best (Montana Bald Eagle Working Group 2016). There has been a steady increase in the number of statewide territories, from less than 100 in 1989 to over 600 in 2010. Nesting bald eagles are territorial (limiting their nesting density), but are well distributed in suitable habitat across the Forest. In 2012 there were twelve nesting territories known to be active on or within 1 mile of Forest lands (K. Dubois, MFWP, pers. comm. 2013).

In Montana, bald eagles nest in very large trees (typically greater than 30 inches d.b.h.) in forests with uneven canopy structure and in direct line of sight of a large river or lake that is generally less than 1 mile away. On the Forest, nests have been located in western larch, ponderosa pine, Englemann spruce and Black Cottonwood trees. There are 10–13 known active nest territories on or immediately adjacent to Forest lands (see Forest Assessment 2014).

Bald eagles generally feed near large rivers and lakes where they prey on fish, waterfowl, and small mammals; steal food from other predators; and scavenge carrion. During the breeding season, important foraging habitat is usually less than 10 miles from the nest. Some eagles stay in the general vicinity of the nesting area during winter while others may migrate up to hundreds of miles to wintering grounds. During the winter, roost trees are used by bald eagles for shelter.

The affected environment describes key ecosystem characteristics associated with a species. The key stressors section which follows provides a foundation for the alternative effects analysis and an understanding of which stressors the USFS has authority to manage. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are activities that might impact a species and its habitat if not managed or mitigated. Stressors that are outside of Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. These are considered under "Cumulative Consequences".

Key stressors under USFS control

Land Management: Timber harvest and other types of vegetation manipulation can affect current and potential nesting habitat by removing nest trees, roost or perch trees, and nest screening cover. Stand-replacing wildfires can eliminate potential nest trees, roost trees and perches. Prolonged loud activities (e.g. blasting or gravel crushing) or recreation use adjacent to a nest site that bald eagles are unaccustomed to may disturb nesting bald eagles.

Key stressors not under USFS control

Land Management: Development of private lands near lakes and large rivers may result in loss of nesting habitat or disturbance to nesting bald eagles. Timber harvest and other types of vegetation manipulation can affect current and potential nesting habitat by removing nest trees, roost or perch trees, and nest screening cover. Prolonged loud activities (e.g. blasting or gravel crushing) or recreation use adjacent to a nest site that bald eagles are unaccustomed to may disturb nesting bald eagles.

Environmental contamination: One of the greatest threats to bald eagles in the U. S. was the high level of "persistent organochlorine pesticides" (such as DDT) occurring in the environment. Because bald eagles are at the top of the food chain, DDT affected successful reproduction by causing egg-shell thinning. DDT was subsequently banned in the U.S. and bald eagle populations grew at exponential rates following the ban. Lead poisoning is still known to occur when bald eagles ingest lead from lead shot, bullet fragments, or sinkers buried in their food.

Collisions: Direct mortality from collisions with power lines or vehicles may occur while bald eagles scavenge roadside carrion. This typically occurs along high-speed highways.

Climate change: An increase in stand-replacing wildfires could result in loss of nest trees, especially if they are located in very dense stands and/or there are ladder fuels present to carry fire into the crown of the nest tree. Bald eagles use large lakes and rivers as well as terrestrial habitats and so are not believed to be sensitive to climate change effects or effects on their wide variety of food sources. They can move long distances to find food.

Summary of alternative consequences

Plan components would support key ecosystem characteristics for bald eagles (as well as other birds of prey). Disturbance would be limited at known nest sites during the nesting season and plan components support diversity of the sites bald eagles use for feeding. The Forest has been helping to protect nesting eagles for decades and would continue to do so with all alternatives. The action alternatives B, C, and D have more management direction to promote the sustainability of very large trees used for nesting and roosting along large lakes and rivers in the valley bottoms.

Environmental consequences alternative A

The USFWS determined that the bald eagle was recovered and the species was de-listed in 1999. The 1986 forest plan provided direction to apply the guidelines and recommendations contained in the Pacific Bald Eagle Recovery Plan (as updated in the Montana Bald Eagle Management Plan; Montana Bald Eagle Working Group 2010) and during site specific analysis. Implementation of the following management direction has contributed to a recovered bald eagle population and would continue to do so:

- Prohibit cutting of snags for firewood within 300 feet of any river, lake, or reservoir.
- Prohibit disturbance-causing activities such as road construction, logging and seismic exploration using explosives within ½ mile of active bald eagle nests during the nesting period February 1 through August 1.

Environmental consequences alternatives B, C, D

Compared to alternative A, the action alternatives place more emphasis on management to promote very large tree presence in the valley areas where many bald eagles nest, by retaining individual trees and by actively managing forest stands to make them more resilient to expected future stressors (see Vegetation section for more details).

Key ecosystem characteristics described in the affected environment would be supported by implementation of plan components for watersheds and RMZs as well as vegetation structure, included in all action alternatives. In addition, species-specific plan components included in all action alternatives would promote retention of existing and future nest/roost trees and reduce the risk of human disturbances known to disrupt nesting. Guideline FW-GDL-TE&V-12 provides more emphasis on retention of key trees used by bald eagles for nesting than in the no action alternative. This guideline states that in the absence of a site-specific analysis that supports an alternative prescription, in vegetation treatment units within 1/2 mile of 40+ acre lakes or 4^{th} order or larger streams suitable for bald eagle nesting, live ponderosa pine, western larch, and black cottonwood trees greater than or equal to 20 inches dbh should be retained.

Guidelines FW-GDL-WL SOI-02 states that active bald eagle nesting territories (see MFWP bald eagle nesting territory database) should be managed in accordance with the listed recommendations of the Montana Bald Eagle Management Guidelines (or subsequent MFWP updates if applicable) (also see appendix C). Guideline FW-GDL-WL SOI-02 limits activities known to disrupt nesting bald eagles within 0.25 miles of known, active nest sites from February to mid-August. Additional standards and guidelines included in alternatives B, C, and D that would limit new developed recreation sites in the grizzly bear primary conservation area could benefit the bald eagle by reducing the risk of nest site disturbance. These potential benefits may or may not occur, depending on site-specific locations and conditions.

Cumulative consequences

The Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act protect bald eagles on all lands. Habitats preferred by the bald eagle in northwest Montana are also expected to continue to change as a result of human land uses on all lands, particularly in the developed valley bottoms where many nesting lakes and rivers are located. On all ownerships, fuels reduction within the WUI could help to protect bald eagle nesting and roosting habitat, provided suitable trees are retained.Private land development on shorelines and increasing recreation use on some lakes may limit nesting habitat or increase disturbance. Continued coordination and mitigation of these effects by multiple agencies will likely continue to be necessary, although many bald eagles now appear to be more tolerant of humans than once thought.

While DDT has been banned in the U.S., bald eagles may continue to be killed by other environmental contaminants (e.g. lead shot or poisons used to kill ground squirrels). This has been a documented source of bald eagle mortality on private lands in recent decades, as has collision with vehicles when bald eagles feed on road-killed animals. Changes in regulations now allow people to remove road-killed big game animals, reducing this risk.These factors cause mortality of individual birds, but do not currently appear to be impacting the population as a whole.

Direct mortality due to poaching of bald eagles was a source of mortality in the past, but has been greatly reduced in recent decades as a result of public education efforts about the important role of bald eagles and other birds of prey.

In summary, the cumulative effects of proposed management actions on the Forest, in the context of all lands of the larger landscape, contribute to the ecological integrity of aquatic, wetland, and riparian wildlife habitats that support bald eagles. This would be accomplished by forestwide plan components for aquatic habitats, wetlands, riparian management zones, and watersheds as well as forestwide plan components to reduce disturbance to nesting bald eagles and protect their nest trees. Bald eagle habitat is abundant and is distributed across all Forest GAs. While the Forest does not have authority over all stressors that may affect bald eagles, the Forest contributes to the ecological conditons that support them.

Wildlife associated with hardwood tree habitats

Introduction

Hardwood trees occur in riparian as well as upland areas. In the mountainous West, hardwood tree communities are disturbance-dependent. Although hardwood trees usually make up less than 10% of forest cover in western forests, they are highly preferred; as nesting and foraging sites for birds, insectivorous mammals, amphibians, and provide a preferred substrate for many invertebrates (Bunnell, Wind, and Wells in USDA GEN Tech Report PSW-GTR-181, 1999).

In 7 of 9 Pacific Northwest studies compiled by Bunnell and others (1999), bird species richness was highest in mixed conifer-hardwood communities containing quaking aspen or cottonwood. While riparian hardwood communities had the highest bird species richness, upland hardwood communities had significantly greater bird species richness than upland conifer communities.

On the Forest, hardwood tree communities are composed of black cottonwood, aspen, paper birch, and water birch. Examples of species associated with hardwood forests are the veery, great blue heron, several sapsuckers, downy woodpeckers, pileated woodpeckers, and black-capped, boreal or chestnut-backed chickadees. In addition, several bat species preferentially roost in hardwood trees, including the little brown bat and silver haired bat. Other mammals such as the fisher, black bear, flying squirrel and red squirrel are known to nest, den or rest in very large cottonwood trees where available. Paper birch is known for loose bark that provides shelter and sap and seeds provide food. (Bunnell, Wind, and Wells in USDA GEN Tech Report PSW-GTR-181, 1999).

Examples of key ecosystem characteristics for many bird species associated with this habitat include soft, decayed, or hollow trunks or a branching structure that provides nesting or foraging sites. For example, great blue herons usually nest in colonies containing a few to several hundred pairs, building bulky stick nests high in the multiple branches of the largest cottonwood trees available. Most Montana nesting colonies are in very large trees sustained by periodic flooding along major river floodplains and lakes. The veery is a small neo-tropical migratory bird that nests in moist, low elevation hardwood forests with a dense shrub understory. They nest in trees, shrubs, or on the ground and do not require trees of large size (Casey 2000). In Montana, veerys are often associated with willow thickets and cottonwood stands along streams and lakes in valleys as well as in lower mountain elevations, including the Flathead region (Skaar 2000). The veery prefers disturbed forest, probably because hardwood trees and denser understory conditions are not found in undisturbed forests (Moskoff 1995). On wide, low gradient rivers (e.g. the Swan River), periodic flooding maintains a very highly convoluted pattern of meanders, sloughs, and oxbow lakes. Because this pattern is changing constantly due to periodic flooding, cottonwoods and shrubs are the predominant vegetation, whereas conifers are more patchy because they only become established in the intervals between flooding events. Beaver activity also helps to maintain cottonwood/shrub communities and compliments the effects of flooding.

Key indicators for analysis of most wildlife species associated with hardwood trees

In addition to key indicators addressed in the Soil, Watershed, Aquatic Species, and Riparian Ecosystems and Vegetation sections of the DEIS, the following indicators are important for the wide variety of wildlife species associated with hardwood tree habitats. The indicators were developed after considering key stressors, public comments, and issues identified during scoping.

- Vegetation management direction to promote hardwood tree presence

Affected environment

On National Forest System lands, there are approximately 11,900 acres of the hardwood tree dominance type and hardwood trees are present on less than 2% of the forest acres, according to FIA data. Nearly 70% of the hardwood tree type is located in the valley bottoms of the Swan Valley GA, and the far north and far south end of the North Fork GA. Hardwoods are often associated with the wet meadows and ponds that occur in these areas. The acreage of habitat suitable for growth of very large cottonwood trees for nesting is naturally very limited on the Forest, ranging from about 273 acres in the Salish GA to about 5,676 acres in the Swan GA, mostly on other land ownerships, with a small portion on Forest lands (see Forest Assessment 2014, for more details). Some upland areas are also capable of growing hardwood trees. On the Forest, aspen and paper birch occur in upland areas and are not as dependent upon seasonal flood flows as cottonwoods are. Increases in wildfire in some geographic areas (e.g. North Fork Flathead River, South Fork Flathead River, and Hungry Horse GAs) since 2003 have increased hardwood trees in upland areas in recent decades. Bunnell and others (1999) recommend encouraging upland patches of hardwoods, avoiding conversion of riparian areas to conifer communities, and controlling domestic grazing in riparian areas to sustain biodiversity.

The affected environment section describes key ecosystem characteristics. The key stressors section which follows provides a foundation for the alternative effects analysis and an understanding of which stressors the USFS has authority to manage. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are activities that might impact a species and its habitat if not managed or mitigated. Stressors that are outside of Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. These are considered under "Cumulative Effects".

Key stressors under USFS control

Land Management: Vegetation management activities such as timber harvest, thinning, prescribed fire use, fire suppression, and livestock grazing can affect the quantity and quality of hardwood tree habitats.

Key stressors not under USFS control

River Flow Management: Regulation of flood flows by Hungry Horse Dam can affect regeneration of riparian cottonwood groves, on the lower South Fork and main stem Flathead Rivers, but not on the North Fork, Middle Fork, Stillwater, or Swan Rivers.

Private Land Development: Private land development in the valleys can affect the availability of hardwood tree habitats.

Summary of alternative consequences

Because deciduous trees and shrubs along low-gradient streams are maintained by periodic flooding, ERG modelled upland riparian deciduous communities that are maintained by other disturbance factors such as fires, insects and disease. ERG's query is designed to assess the availability of habitats that provide shrubs and deciduous trees within RHCAs/RMZs. For the current condition, a GIS layer including the locations of all VMAP polygons with cover types dominated by shrubs and deciduous trees was used. For purposes of modeling future vegetation treatments, there were minimal treatments in landscape areas mapped as RHCAs/RMZs because these areas are not suitable for timber production. Future habitat was modelled as forest openings containing riparian shrubs and hardwood trees resulting from moderate or high severity wildfires and insect/disease within 20 years following disturbance.

The model predicts all alternatives would stay within the minimum and maximum range of NRV over the 5 decade time period. Acres of riparian habitat in an early succession condition that provide dense shrubs and deciduous trees decline slightly during the first two decades, followed by increasing habitat that returns to near current levels for Alternatives B and D. Alternative A stays well below current levels, probably because the wildfires are suppressed in the model and there is no prescribed burning. Alternative C slightly exceeds current levels by decade 5, likely because this alternative has the most recommended wilderness and prescribed burning to meet desired conditions. Since upland riparian areas generally produce substantially higher levels of shrubs after a reduction in canopy closure, it may not matter much whether that loss in canopy occurs from fire, insects, disease, or vegetation management. Consequently, it is likely that habitat for riparian species associated with shrub and hardwood habitats will stay at or above current levels assuming that modeled increases in natural disturbances are highly probable by the end of decade 5.

Environmental consequences alternative A

Amendment 21 includes the forestwide objective #6-Veg, to encourage cottonwood, birch, aspen, western red cedar, and western larch as stand components in areas to which these species are best adapted. Where consistent with watershed, fisheries and other riparian objectives and standards, implement management activities to achieve this objective through actions such as planting, thinning, and prescribed fire.

While the no action alternative provides some direction to maintain hardwood trees, it does not have specific objectives to increase hardwoods. As a result, other management objectives have often received greater management consideration, resulting in a lack of hardwoods in some portions of the Flathead Forest landscape, when compared with NRV.

The Forest has grazing allotments in two geographic areas, the Salish Mountains and Swan Valley GAs. This alternative has no restrictions on future grazing allotments.

Environmental consequences alternatives B, C and D

All action alternatives would contribute towards maintaining or improving nesting, denning, roosting, and foraging habitat for species associated with hardwood trees on NFS lands. This is due to plan components that recognize the importance of hardwood trees in providing biodiversity and would maintain or increase them on suitable sites. With the action alternatives, hardwood trees are addressed by desired conditions FW-DC-TE&V-10 and FW-DC-WL-SOI-03 and 04. Standards FW-STD-GR-04, 08, and 09 and GA-SV-GDL-06 would limit cattle grazing allotments on NFS lands, decreasing the risk that hardwood tree habitats would be impacted by cattle grazing.

The revised plan includes vegetation management objective FW-OBJ-TE&V-03. This objective is not included in modelling of alternatives, but would promote treatments (e.g. timber harvest, planned ignitions, thinning, planting) to increase hardwoods on 500 to 5,000 acres of forest, to contribute to increased presence of hardwood trees. This is especially important in areas where hardwoods are not regenerated by flooding and where conifer competition reduces hardwoods (also see the hardwood trees section of 3.3.4 Vegetation Composition).

Cumulative consequences common to most species associated with hardwood tree habitats

This section summarizes activities and effects that are common to most species associate with hardwood tree habitats.

In the past, hardwood trees in upland areas were considered to be competitors with the higher-value coniferous trees in many western forests so they were not been maintained or promoted. Fire suppression in some areas has reduced hardwood tree presence. In recent years, paper birch has become more valuable for firewood and is likely to continue to be a popular firewood tree in the future.

In the past, very large cottonwood trees may have been removed due to private land development or changes in water flow due to impoundments, such as Hungry Horse Reservoir, but there are no records of how many trees or groves have been lost. There are hardwood trees with dense shrubs on state or other federal lands along the major river floodplains of the Forest, including groves of large cottonwoods along the Forest boundary of Glacier National Park and in the wildlife refuge at the south end of Swan Lake. Cottonwood groves in these two areas would be protected, unless they are killed by wildfire. In the future, increases of high severity wildfires may kill very large cottonwood trees. Additional streams have been listed as eligible for wild and scenic river designation with all alternatives, so their outstanding remarkable values would be maintained. Designation of rivers as wild and scenic would prevent impoundments in the future, benefitting hardwood tree habitats.

In the future, riparian areas on private lands of the Flathead Valley are likely to continue to be developed, resulting in loss of hardwood tree habitat or increases in other nest predator species associated with human developments.

In summary, the cumulative effects of proposed management direction on the Forest, in the context of all lands of the larger landscape, contribute to the hardwood tree habitats. This would be accomplished by plan components to maintain or increase hardwood trees on suitable sites. While the Forest does not have the ecological capacity for much hardwood tree habitat, ecological conditions that support hardwood tree habitat, such as wildfire and natural flood processes, would be supported on NFS lands.

Wildlife associated with cliff, cave, and rock habitats

Introduction

Cliff, cave, and rock habitats are inherently stable for long periods of time and are changed primarily by geologic forces. There are about a dozen species associated with these habitats on the Forest. Examples of key ecosystem characteristics include cliffs used for nesting by many bird species; caves, crevices and rock outcrops used for roosting and hibernating by many bat species, as well as boulder and talus accumulations used by some mammals for hibernation, shelter from the weather, or to escape from predators. Examples of species include the mountain goat, white-throated swift, turkey vulture, northern alligator lizard, Cordilleran flycatcher, peregrine falcon, hoary marmot, pika, bushy-tailed woodrat, cliff or violet-green swallow, and a variety of bat species. These species are found across the forest, but have spotty distribution, because their habitats have naturally spotty distribution. Cliff, cave, and rock habitats make up 2% or less of the Flathead ecosystems.

Some species associated with boulders and talus habitats, such as the pika and hoary marmot, are restricted to alpine and sub-alpine habitats. Pikas tend to make short-distance movements to gather vegetation next to talus slopes, which they store in rock crevices, whereas marmots travel further to feed in meadows (MNHP 2015). These two species are not known to be sensitive to human disturbance and observed most frequently in the Flathead's wilderness areas, where there are virtually no human activities that affect their habitat. There is no inventory of talus slopes and boulders on the Forest.

Temperature, access by predators, and proximity to foraging habitat and water are some of the factors influencing habitat selection by bats. Most rock crevice roosts are well protected from predators, but do not often provide suitable hibernating sites for the winter season due to high temperature fluctuations. Caves and mines are extensively used by bats for roosting, where bats will roost in clusters in microsites within the cave that help trap body heat and raise the temperature. Size, configuration, and complexity of the cave or mine influences microclimate by affecting airflow, air temperature, and humidity. Particular caves and mines may not be equally suitable for different types of roosting during all times of the year (Rancourt, Rule, & O'Connell, 2005).

Key Indicators for most wildlife species associated with cliff, cave, and rock habitats

The indicators used to focus the analysis and disclose relevant environmental effects were developed after considering key stressors, public comments, and issues identified during scoping.

- Human disturbance of cliff, cave and rock habitats**.**

Affected Environment

Population, life history, habitat, and distribution:

The public expressed an interest in five species associated with cliff and rock habitats. The Townsend's big-eared bat (SCC) and two other bat species, the mountain goat, and peregrine falcon. In addition to the Townsend's big-eared bat, 11 other species of bats have been detected by acoustic surveys on the Forest (A. Shovlain, USFS Wildlife Biologist, pers. comm. 2011). These include all 8 Myotis species known to occur in Montana, the big brown bat, the silver-haired bat, and the hoary bat. Some members of the public expressed a concern for the long-eared myotis and long-legged myotis. These two bat species are numerous and widespread across western Montana (B. Maxell, MNHP, unpublished data 2015). One bat species is specifically addressed in this section, but effects to other bat species may be similar. In addition to coarse filter plan components, there may be species-specific plan components to address their needs. The first part of this section describes key stressors that are applicable to this habitat and then potential consequences to example species are described. For detailed information on the population and life history of these species refer to the Montana Field Guide (http://fieldguide.mt.gov) and the Montana Partners in Flight Bird Conservation Plan (Casey 2000).

Caves provide the primary habitat for roosting and hibernating of most bat species in Region 1 (USDA FS 2013, unpublished report) (Maxell 2015 unpublished report). There are a large number of caves on Forest lands, with a wide variety of lengths and depths. Very few of the caves have been inventoried to determine bat presence or absence and the number that have environmental conditions that could support hibernating bats or maternity roosts is unknown. The highest number of caves on the Forest is in the South Fork and Middle Fork GAs; where about 163 caves and relatively large rock crevices have been identified within the Bob Marshall Wilderness (see planning record exhibit V-7). The majority of caves in the Bob Marshall Wilderness have little or no use by people due to the difficulty of accessing them, so they provide a high level of security from disturbance for roosting and wintering bats.

Cliffs occur across the Forest at all elevations. Cliffs are located near water at Tally Lake and Tally Lake Gorge, along the Flathead River between Columbia Falls and Hungry Horse, and along the South Fork Flathead River south of Hungry Horse Reservoir and west of Flathead Lake.

The affected environment section describes key ecosystem characteristics. The key stressors section which follows provides a foundation for the alternative effects analysis and an understanding of which stressors the USFS has authority to manage. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are activities that might impact a species and its habitat if not managed or mitigated. Stressors that are outside of Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. These are considered under "Cumulative Effects".

Key stressors under USFS control

Blasting, crushing, or removal of rock: On NFS lands, these activities are under the authority of the Forest Service (see salable minerals in the Energy and Minerals section of Chapter 3 for more details).

Human disturbance of cliff, cave and rock habitats: On NFS lands, closure of caves to reduce vandalism, reduce human disturbance to bats, or reduce spread of disease is under the authority of the Forest Service.

Key stressors not under USFS control

Climate Change: Species such as the hoary marmot and pika may be susceptible to summer heat stress associated with summer warming. In the northern Rocky Mountains, the temperature tolerance limits of pika are not likely to be reached in the near future (NRAP 2015). Specific microhabitat features such as local moisture sources, the physical structure of talus fields, and northerly aspects may help to buffer the effects of climate changes (Millar and Westfall 2010).

Disease: White-nose syndrome is a disease that kills large numbers of some species of bats. As of 2016, this disease has been documented in Washington as well as the central states such as Missouri (https://www.whitenosesyndrome.org/resource/updated-wns-map-january-23-2015) In other states, white-nosed syndrome has been documented in two of the bat species known to occur on the Forest, the big-brown bat and the little brown bat (B. Maxell, MNHP, unpublished data 2015).The USFS cannot control the spread of disease from people to bats because bats can fly long distances across many land ownerships, but the USFS educates cavers about bats and the importance of decontamination to prevent the spread of diseases such as White-nosed syndrome.

Summary of alternative consequences

Plan components in the action alternatives would support key ecosystem characteristics associated with these habitats. While these habitats are created by geologic forces that are very stable, some of the species associated with them are sensitive to human disturbance (see discussions of individual species below).

Environmental consequences alternative A

There is no management direction specific to cliff and rock habitats, but there is management direction for specific species (such as peregrine falcons) associated with this habitat, as detailed below.

Environmental consequences action alternatives B, C, and **D**

Guideline FW-GDL-ECOS E&M-06 states that available resources at existing gravel pits should be used before constructing new pits. Desired condition FW-DC-TE&V-05 states that uncommon habitat elements (e.g. rocky outcrops and cliffs, scree and talus slopes, caves, waterfalls) provide high quality habitat for associated animal (vertebrate and invertebrate) and botanical species (also see wildlife section). Guideline

FW-GDL-WL SCC-01 states that if mines, caves, or old buildings are closed to reduce safety hazards or vandalism, bat-friendly closures should be installed to maintain bat access, unless surveys indicate bats are not present and habitat is unsuitable. Buildings and bridges should be inspected prior to removal or reconstruction to identify bat use. When bats are present, removal should not begin until bats have left for the season. If old buildings or bridges are removed and are not replaced, bat structures should be installed to provide habitat (also see appendix C). Guideline FW-GDL-WL SCC-02 Management actions (e.g. decontamination measures, avoidance of human entry to winter roosts during winter, signs, education of cavers) should be adopted as needed to help prevent or curtail spread of White-nose Syndrome from cave to cave. For other species-specific plan components, see the sections below. These plan components would also benefit numerous species associated with cliff, cave, and rock habitats.

Cumulative consequences to most species associated with cliff, cave, and rock habitats

This section summarizes activities and effects that are common to most species associate with cliff, cave, and rock habitats. Also see the individual “Cumulative Effects” sections specific to species in the wildlife analysis of this DEIS.

Activities which may affect this species group in the future are those which are likely to increase on all land ownerships due to human population growth. Widening of highways and blasting of cliffs may occur in the future, but most cliffs are on state, national forest system lands, or in Glacier National Park (adjacent to the Forest), where the value of cliffs in providing wildlife habitats is recognized and the risk of cliff habitat loss is very low. There have been very few past impacts to high elevation talus and boulder habitats on the Forest because they are within wilderness (figure 1-01) and inventoried roadless areas (figure B-02). High elevation talus and boulder areas are also protected in Confederated Salish and Kootenai Tribal wilderness areas and in Glacier National Park. Most gravel pits on the Forest and on other land ownerships are in areas where glacial till deposits occur, so talus and boulder areas are not impacted.

Caving and rock-climbing are popular recreational activities in some areas and may increase in the future. Most caves are on NFS lands or in Glacier National Park (adjacent to the Forest), where their value in providing habitat for bats is recognized. While the majority of caves are not accessible for much of the year, caves which are very accessible have experienced vandalism, requiring installation of protective doors in some cases. Plan components that specify use of bat-friendly gates would help to make caves accessible to bats while protecting the cave resource. Plan components to educate cavers about the risk of spreading disease would also help to protect bats. Because both people and bats may carry diseases and travel long distances, disease can be spread across a wide area. Disease control requires a cooperative effort. Multiple agencies are monitoring bats, which will help to support adaptive management.

Recreational cave/mine exploration on all land ownerships can lead to increased rate of spread of diseases such as white-nose syndrome. There is a decontamination protocol in place for NFS lands, which should aid in slowing the spread on national forest system lands, but diseases may continue to be spread elsewhere.

In summary, the cumulative effects of proposed management actions on the Forest, in the context of all lands of the larger landscape, contribute to the ecological integrity of cave, cliff, and rock habitats. This would be accomplished by plan components to use available resources at existing gravel pits before constructing new pits, to keep caves accessible to wildlife if they are closed for safety reasons, and to use measures to prevent spread of disease from cave to cave. While the Forest’s ecological capacity to provide cliff, cave and rock habitat is limited by geologic factors, this habitat would be supported on NFS lands.

In addition to the indicators and effects of alternatives described under "Wildlife associated with cliff and rock habitats", the following sections describe the affected environment and additional indicators and consequences that apply to specific species associated with cliff and rock habitats.

Townsend's big-eared bat (SCC)

Key indicators for analysis

In addition to the indicators and effects of alternatives on feeding and roosting habitat described under "Wildlife associated with aquatic, wetland and riparian habitats" and "old growth and very large trees," the following species-specific indicator applies:

- Plan components to support key ecosystem characteristics for the Townsend's big-eared bat

Affected environment

Population, life history, habitat, and distribution: This species is listed as a species of conservation concern by the regional forester (see www.fs.usda.gov/goto/flathead/SCC). The Townsend's big-eared bat is distributed across the western U.S., southwestern Canada, and Central America. Range wide, there may be a decline (NatureServe 2015, Gruver and Keinach 2006). In Montana, this species has been documented across all but the northern tier of the state (MNHP 2015), but the population and trend is unknown (Maxell 2015). Intensive population surveys of bats are difficult to conduct because of the nocturnal behavior of bats, their large home ranges, and difficulty of species identification while in flight. Recent acoustic surveys of bats have provided additional information on occurrence. However, "Townsend's big-eared bats are unusually difficult to survey for because they are quite effective at avoiding mist-nets and difficult to detect acoustically because they use low-intensity calls" (Hendricks and Maxell 2005).

The Townsend's big-eared bat inhabits Montana on a year-round basis and occurs at low density due to limited availability of caves used for hibernating and roosting habitat. Cave and mine availability may limit dispersal. Adults appear to have high fidelity to roost sites (Maxell 2015). On the Forest, this bat has been observed in 2 known winter hibernating sites (see project record exhibit V-8). There are no known maternity roosts and two known summer day and night roosts on the Forest (http://mtnhp.org/animal/presentations/Montana_Bats_Distribution_Status_and_Roost_Overview_20150224.pdf). Many of the caves on the Forest have not been inventoried for presence of bats, but the forest is currently gathering valuable information from a volunteers. Statewide there are 3 known maternity roosts (2 in caves, 1 in a mine) and 39 winter hibernating sites (Maxell 2015).

This bat uses caves, cave-like structures, and mines for wintering, giving birth, and roosting. Bridges can be important day roost sites. Caves in a complex with diverse aquatic and riparian habitats for feeding are key ecosystem characteristics. A key component of habitat for the Townsend's big-eared bat is roosting habitat; including maternity roosts where bats give birth and raise their young, hibernacula where bats spend the winter, day roosts where bats rest during the day, and night roosts where bats congregate at night when they are actively feeding. Winter and summer roost sites may be limited based on temperature and airflow requirements. Females form maternity colonies during the spring and summer, which are typically composed of 20 to 180 females. According to MNHP, most caves and mines in Montana appear to be too cool in summer for use as maternity roosts. In Montana, daytime roosts may include snags and old buildings (Genter and Jurist, 1995).

The foraging behavior of this bat has not been reported or studied in Montana. In California, the mean center of feeding activity was 2 miles from caves for females and 0.8 miles for males (Fellers and Pierson

2002). Townsend's big-eared bats feed on various nocturnal flying insects near the foliage of trees and shrubs, especially near beaver pond complexes, meadows, and streams.

The affected environment describes key ecosystem characteristics associated with a species. The key stressors section which follows provides a foundation for the alternative effects analysis and an understanding of which stressors the USFS has authority to manage. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are activities that might impact a species and its habitat if not managed or mitigated. Stressors that are outside of Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. These are considered under "Cumulative Consequences".

Key stressors under USFS control

Land Management: The Forest has one old mine as well as old buildings on NFS lands. Closure of caves or mines used as winter hibernation sites or maternity roosts can reduce or eliminate key habitat. Riparian management can affect feeding and roosting habitat.

Human disturbance at maternity roosts or in winter hibernacula: A primary cause for decline has been listed as human disturbance at caves (Pierson et al. 1999). Disturbance by humans is believed to play a role in the short-term dynamics of local populations, but in some cases what has been interpreted as site abandonment may be normal movement patterns (Sherwin et al. 2003). Human use levels of caves in the plan area are not known, but many cave entrances on the Forest are plugged by snow during winter and many are in remote wilderness locations where they are difficult to access on a year-round basis. Only one cave closure has been necessary on the Forest to protect cave resources.

Key stressors not under USFS control

Land Management: Most caves are on public lands, but old buildings or bridges used as roosts may be found on other land ownerships. Management of lakes and rivers can affect feeding and roosting habitat.

Climate change: Climate influences food availability; timing of hibernation; timing and duration of seasonal migrations; frequency and duration of torpor; rate of energy expenditure; and reproduction and juvenile development in bats. Changes in climate or the frequency, magnitude and severity of disturbances such as fire and insect outbreaks could have an impact on this and other bats, but are not currently well understood (Sherwin et al. 2013).

Disease: White-nose syndrome (WNS) is a disease that kills large numbers of some species of bats. The Townsend's big-eared bat is listed as a vector for WNS, but not listed as being susceptible to mortality (http://mtnhp.org/animal/presentations/Maxell_Bat_Roost_Surveillance_20150226.pdf).

Summary of alternative consequences

Plan components would support key ecosystem characteristics of Townsend's big-eared bats (as well as other bats) by protecting caves and old mines used for hibernating and roosting, promote snags used for day roosts, and support diversity of the aquatic, wetland, and riparian sites used for feeding. Human use levels of caves in the plan area are not known, but many cave entrances on the Forest are plugged by snow during winter and are difficult to access on a year-round basis. The action alternatives also include plan components to limit disturbance at caves used for maternity roosts or hibernating sites during key time periods.

Environmental consequences alternative A

The 1986 Forest plan does not have management direction specific to Townsend's big-eared bats, but does provide direction for management of caves. The current forest plan states that the Forest will "Preserve and protect caves for their unique environmental, biological, geological, hydrological, archaeological, paleontological, cultural and recreational values." This management direction helps to prevent some disturbances to caves that have the potential to threaten this bat species. However, management direction does not specifically address human disturbance or spread of disease.

Environmental consequences alternatives B, C, and D

Key ecosystem characteristics described in the affected environment would be supported by implementation of coarse filter plan components for watersheds and RMZs as well as vegetation structure, to maintain or improve roosting and feeding habitat.

Desired condition FW-DC-SCC-WL-01 states that caves, old mines, old buildings, tunnels provide areas for roosting, hibernation, or maternity sites. Caves and mines with evidence of use by Townsend's big-eared bats are accessible to bats. Where possible, old mines and buildings that are used for maternity roosts and hibernacula are stabilized and conserved. Cavers are knowledgeable about and apply techniques to prevent the spread of disease to bats. Beaver ponds, other wetlands, and riparian areas provide feeding habitat. There are low levels of human disturbance at sites known to provide maternity roosts or hibernacula for the Townsend's big-eared bat. Guideline FW-GDL-SCC-WL-01 states that if mines or caves are closed to reduce safety hazards or vandalism, bat-friendly closures should be installed to maintain bat access, unless surveys indicate bats are not present and habitat is unsuitable. Buildings and bridges should be inspected prior to removal or demolition to identify bat use. When bats are present, removal should not begin until bats have left for the season (also see appendix C). Guideline FW-GDL-SCC-WL 02 states that cavers are informed of techniques needed to prevent the spread of disease to bats. If White-nosed Syndrome is documented in Montana, management actions (e.g. decontamination measures) should be adopted as needed to prevent or curtail spread of the disease.

Cumulative consequences

Many people are intolerant of bats and this can lead to disturbance of bats, loss of access to roost sites, or mortality. Biologists in Montana are working to increase public understanding of bats and their ecological role as insect predators.

Past timber harvest on all lands has likely altered availability of snags used for roosting in some localized areas, but insects and disease, as well as increases in wildfire (recently and anticipated in the future) have created abundant snags which can be used for roosting across the landscape (including Glacier National Park adjacent to the Forest, and in riparian forest habitats, wilderness areas, and inventoried roadless areas).

Aquatic, wetland, and riparian habitats host an abundance of insects, in addition to water for bats. The Townsend's big-eared bat uses large lakes and rivers for feeding which may have high levels of human development, if surrounded by private lands. Lights associated with human developments may attract insects which bats feed upon (and also bats), while use of insecticides can decrease insects bats feed upon. Since bats are nocturnal, human disturbance has a minor direct effect on feeding.

Climate change could alter prey abundance, but because these key ecosystem characteristics are abundant on the Forest, this effect is expected to be minor. Grazing will continue on other ownerships, and if it reduces the availability riparian shrub habitats, there could be a reduction in bat foraging habitat. Grazing has declined on the Forest in recent decades and there are standards to limit increases in the future, thus supporting foraging habitat on NFS lands.

Surface temperature changes may change the interior temperatures of caves and abandoned mines. As bats are selective in the microclimates in which they will roost, this may cause bats to shift their use elsewhere inside caves or abandon some altogether. There is currently a high degree of uncertainty regarding temperature changes in caves, but a volunteer caving group is helping to monitor this factor.

In summary, the cumulative effects of the proposed forest plan alternatives, in the context of all lands of the larger landscape, would contribute to the ecological integrity of cave, rock crevice, aquatic, wetland, and riparian habitats that support the Townsend's big-eared bat. This would be accomplished by plan components to limit the risk of cave and mine habitat loss due to closure, to promote roosting and feeding habitat, and to educate cavers. The abundance and distribution of caves providing potential maternity roosts and hibernacula on the Forest is naturally limited by geology and this limits the ecological capability to provide habitat. In addition, there are many remote wilderness caves where assessment of cave suitability and identification of individual species has not been determined. While the Forest does not have the authority over all stressors that may affect the Townsend's big-eared bat, the Forest contributes to the ecological conditions that support them.

Mountain Goat

Key indicators for Analysis

The public expressed an interest in this species during scoping. In addition to the indicators and effects of alternatives on habitat described under "Wildlife associated with cliff, cave and rock habitats", the following species-specific indicator applies to the mountain goat:

- Human disturbance of summer and winter mountain goat concentration and kidding areas

Affected Environment

<u>Population, life history, habitat, and distribution</u>: The mountain goat is distributed across most of British Columbia as well as mountainous regions of Alaska, Washington, Idaho, Montana, and Colorado. Mountain goat densities are highest in Glacier National Park and adjacent Wilderness and roadless areas of the Forest, including the Bob Marshall Wilderness complex, the Mission Mountain Wilderness, Jewel Basin Hiking Area, and adjacent high elevation lands. These areas are located in the Swan Valley, Hungry Horse, South Fork, and Middle Fork GAs. The Salish Mountain and North Fork Flathead GAs do not have mountain goat populations.

Weaver developed models of mountain goat habitat for the Forest and determined that there were about 61,600 acres of winter habitat and about 189,600 acres of summer habitat. Weaver's summer and winter habitat data layers were discussed with MFWP biologists and were used to supplement information used in the Assessment (Weaver 2014).

Mountain goats feed on grasses, sedges, lichens, forbs and shrubs which are even available on windswept or south-facing rock ledges during the winter. Mountain goats are usually found in the most rugged mountainous areas of steep cliffs and rock bluffs, narrow ledges, rocky canyons, talus and rock slopes. In winter, they use cliffs on south-facing slopes and wind-swept areas where snow accumulations are lower (Varley N., *IN* McCarthy, John and Moore, Fay, compilers; 1988). They are considered non-migratory, although there may be movement from high elevation summer habitats to slightly lower elevations during the winter period. In northwestern Montana in the Swan Range, mountain goats occur at elevations of about 5,000 feet to 7,600 feet (T. Thier MFWP, pers. comm. 2016). Highly traditional behavior restricts mountain goats to regular seasonal use patterns.

The kidding time period when females are giving birth to young is a critical time period for mountain goats. Compared to other ungulates, mountain goats have low reproductive success and survivorship of goat populations is closely tied to the health of mountain goat nursery groups (Baily 1991, Festa-Bianchet et al. 1993). Winter is also a critical time period for mountain goat survival. Compared to other North American ungulates, mountain goats have a high natural mortality rate (Chadwick 1973). Mountain goat populations on the Forest are also affected by mortality due to hunting, but the impact is minimal given the small number of annual permits issued and the low success rate of permitted hunters.

Weaver developed models of mountain goat habitat for the Forest and determined that there were about 61,600 acres of winter habitat and about 189,600 acres of summer habitat. Weaver's summer and winter habitat data layers were discussed with MFWP biologists and were used to supplement information used in the Assessment (Weaver 2014).

All or portions of about half a dozen mountain goat hunting districts occur on the Forest. Mountain goats are hunted under a permit drawing system with mandatory reporting that is regulated by MT FWP. In the Bob Marshall Wilderness complex, mountain goat populations appear stable in recent years, but below historic population levels. MFWP reduced the number of permits in an effort to increase populations. After extensive aerial surveys in both the Cabinets and the Bob Marshall Wilderness complex, biologists observed an overall recruitment rate of 27 kids per 100 adults in 2008, indicating good kid production (see planning record exhibit V-9). A survey of Hunting District #140 conducted by MFWP in 2013 detected 50 mountain goats in the area from the Middle Fork Flathead River to the Hungry Horse reservoir and the ratio was 32 kids:100 adults—the highest kid production recorded since 1982 (see planning record exhibit V-10.

Some types of human disturbance have been shown to alter goat behavior and cause a physiological response (Jim Williams, MT FWP, pers. comm. 2015). In summer, mountain goats are tolerant of humans on foot and also to predictable traffic on roads. However, sudden loud noises such as blasting or low altitude helicopter flights, elicited extreme alarm responses by goats (Varley N., *IN* McCarthy, John and Moore, Fay, compilers; 1988). In winter, goats are at risk to disturbance due to recreation activities.

Varley's review of human disturbance on mountain goats concluded that human disturbance such as over-snow motor vehicle use on mountain goat winter habitats is rare due to the steepness, ruggedness, and low snow accumulations of mountain goat winter habitats. Snowmobilers seek out the deep snow that mountain goats avoid. However, the author noted that the use of helicopters within 1 mile of winter habitat (e.g. used to drop of backcountry skiers in remote areas) may pose a threat to mountain goats in winter (Varley, Nathan, In: McCarthy, John; Moore, Fay, compilers; 1998).

Aircraft overflights can alter mountain goat behavior and cause negative physiological responses which may reduce survivorship (Geist 1978). Foster and Rahs (1983) reported that mountain goats in British Columbia responded to aircraft with a "severe flight response" during 33% of observations. Fifty-five percent of severe flight responses were observed when disturbances occurred at distances less than about 500 feet. Response behavior was correlated with distance to disturbance and the distance at which the disturbance was visible, as well as to available security cover, but was not dependent on time of year, group size, or direction of the approach from above or below. Foster and Rahs (1983) also detected temporary range abandonment as a result of disturbance. Recommended separation from known mountain goat habitat (especially nursery groups) ranges from about 500-650 feet (Foster and Rahs 1983, Haynes 1992, Cote 1996, Wilson 2004 *IN* Wilson and Shackleton 2001*).* Penner (1998) found that the strongest responses were elicited by helicopters. Of the available literature, Côté (1996) and Foster and Rahs (1983) studied the effect of helicopters on Mountain Goats based upon observational data. Both studies independently suggested a 1.25 mile buffer around mountain goats to completely avoid harassment.

Females show strong fidelity to established seasonal ranges, whereas males are more likely to cross ranges to access females during the breeding season (Chadwick, Douglas H. 1977. Ecology of the Rocky Mountain goat in Glacier National Park and the Swan Mountains, Montana. Final Report. West Glacier, MT: U.S. Department of the Interior, National Park Service, Glacier National Park. 54 p). Mountain goats may cross highways.

Behavior of mountain goats in relation to crossing of U.S. Highway 2 near Glacier National Park was studied by Singer (Singer 1978), leading him to recommend construction of a highway crossing to reduce mortality of goats. Two highway underpasses were subsequently constructed during highway reconstruction by the U.S. Department of Transportation and Montana Department of Highways [Transportation]. These underpasses received high levels of use by mountain goats and crossing success increased (Singer and Doherty 1985).

The affected environment describes key ecosystem characteristics associated with a species. The key stressors section which follows provides a foundation for the alternative effects analysis and an understanding of which stressors the USFS has authority to manage. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are activities that might impact a species and its habitat if not managed or mitigated. Stressors that are outside of Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. These are considered under "Cumulative Consequences".

Key stressors under USFS control

Human Disturbance: Blasting and low altitude fixed-wing or helicopter flights can disturb mountain goats, especially during the time periods when they are raising young or during the winter. Mountain goats may become habituated to humans on trails.

Key stressors not under USFS control

Legal hunting or poaching: Mountain goats are hunted under a permit system and season that is regulated by MFWP.

Highway collisions: Mountain goats may be killed when crossing highways.

Climate change and weather: Effects of climate change on mountain goats is currently being investigated.

Summary of alternative consequences

Plan components would support key ecosystem characteristics for mountain goats because their cliff habitats would have low levels of disturbance during key time periods. Most of the Forest's mountain goat habitat is in steep, rugged, remote terrain within existing wilderness and Inventoried Roadless Areas, where there is a relatively low level of human disturbance. Motorized use and mechanized transport does not occur in existing wilderness unless helicopter use is specifically approved (e.g. for emergencies). With all alternatives, plan components to limit motorized access in grizzly bear habitat also benefits mountain goats (also see grizzly bear section of chapter 3). Alternatives differ with respect to areas suitable for motorized over-snow use (see figures 1-11 to 1-14, mountain goat habitat and over-snow suitability).

Environmental consequences alternative A

The current forest plan does not have management direction specific to mountain goats, but has an objective to provide sufficient habitat to contribute to meeting the objectives of MFWP management plans (page II-8). Management direction for the Jewel Basin Hiking Area (which overlaps areas of summer and winter mountain goat habitat) does not allow motorized use, reducing the risk of mountain goat disturbance. With this alternative, existing motorized over-snow vehicle use would continue where it is currently allowed, with minor area that overlaps winter mountain goat habitat (see figure 1-11).

Environmental consequences alternatives B, C, D

Forestwide guideline FW-GDL -WL-SOI-01 limits impacts to known mountain goat winter concentration and kidding areas from December to July and this would apply to activities such as low altitude helicopter flights or blasting. Regardless of the alternative, the risk of disturbance to mountain goats from motorized over-snow use or wheeled motorized trail use would be minor, because most mountain goat habitat on the Forest is already in existing Wilderness, backcountry non-motorized use areas, or in the Jewel Basin hiking area where these uses are not allowed. In addition, cliffs used by mountain goat during kidding or wintering are steep and inaccessible. Mountain goats are generally tolerant of people on trails and may even become habituated to people. Mountain goat conflicts with people have been documented in areas of the Forest where people hike with dogs in mountain goat habitat.

While all alternatives have a very low risk of disturbing mountain goats because they use very steep terrain, alternative C is slightly more protective because all modelled mountain goat habitat would be in recommended wilderness. With this alternative, mechanized transport or motorized use would not be suitable (e.g mountain bikes, chainsaw use)(see figures 1-11 thru 1-14).

Cumulative Consequences

Mountain goat habitat is found in Glacier National Park, adjacent to the Forest. In the past, connectivity between Glacier National Park and NFS lands in the Middle Fork Flathead River has been maintained by an existing highway underpass that is used by mountain goats to access a mineral lick on the Forest Service side of Highway 2. Glacier National Park, encompassing about a million acres adjacent to the Forest, is closed to mountain goat hunting.

Past habitat management and hunting of mountain goats has been at levels that have sustained the population in most areas, with the possible exception of the Whitefish Range, where they have been absent for close to 50 years. Mountain goats occurred along the Whitefish Divide in the North Fork GA at one time, but were probably over-harvested at a time when road access made goat hunting easier (T. Thier MFWP pers. comm. 2011). In the past few decades, the Forest has closed many miles of roads in the Whitefish Range. MFWP may reintroduce mountain goats to an area of the Whitefish Range in the future, but this is currently highly uncertain.

Mountain goats may be affected by increases in recreation near their kidding areas or winter habitat, but in the Jewel Basin and adjacent Glacier National Park, they generally appear to be tolerant of people and may even become habituated to people. Mountain goats are generally not tolerant of dogs, so people hiking with dogs have been known to have conflicts with mountain goats. Recreation personnel in the Glacier Park and Jewel Basin are working to educate hikers to reduce the risk of conflicts.

Research on mountain goat/human interactions and impacts from climate change are underway in Glacier National Park. In the future, summer heat stress and the timing of snow melt may affect mountain goats, however, there is a high level of uncertainty about the effects of winter climate change at the highest elevations where mountain goats live. Glacier National Park, CSKT tribal lands, and Forest lands provide a combined acreage of over 2 million acres where disturbance to mountain goats is relatively low.

In summary, the cumulative effects of proposed management actions on the Forest, in the context of all lands of the larger landscape, contribute to the ecological integrity of cliff and rock habitats that support mountain goats. This would be accomplished by forestwide plan components for cliff, cave and rock habitats as well as forestwide plan components to reduce disturbance to mountain goat kidding and winter concentration areas. Mountain goat habitat is limited by geology, but is distributed across all Forest GAs except the Salish Mountains GA. While the Forest does not have authority over all stressors that may affect mountain goats, the Forest contributes to the ecological conditons that support them.

Peregrine Falcon

Key indicators for analysis

The public expressed an interest in this species during scoping. In additional to coarse filter plan components for cliff, rock, and cave habitats and associated wildlife, the following species-specific indicator applies to peregrine falcon:

- Human disturbance near active nest sites

Affected Environment

Population, life history, habitat, and distribution: The peregrine falcon is a large neo-tropical migratory bird known to breed across Montana and winter in Mexico and South America. Peregrine falcons are breeding or permanent residents across most of the western United States. They were formerly listed under the Endangered Species Act (ESA). Nation-wide estimates of territory occupancy, nest success, and productivity had all substantially exceeded the target values needed to sustain recovery of the species and the peregrine falcon was de-listed from the endangered species list in 1999 (USFWS 1999; Federal Register Vol. 64, No. 164, pp. 46542–46558). Peregrine falcon population biology, ecology, habitat description and relationships identified by research are described in (USFWS 2003), the Montana Natural Heritage Program (MNHP 2015) and NatureServe (2011) websites.

Chemical contaminants used in the 1940’s built up in the food chain and caused egg shell thinning so that peregrines were unable to produce young. Peregrine falcon populations crashed over most of their known range and by the early 1980’s and there were no known nesting peregrine falcons in the state of Montana. The number of known active Peregrine Falcon territories in Montana has increased dramatically from 14 in 1994-96 to 108 active territories in 2012. The accumulated number found active during the survey years 1998-2014 is 165 (http://www.montanaperegrine.org/Peregrine-Watch.html obtained May 2015).

The Montana Peregrine Institute monitors peregrines (www.montanaperegrine.org/index.html).As of 2015, there are 13 reported breeding territories within the Forest geographic areas; 4 in the Flathead River watershed, 1 in the Swan, 2 in the Stillwater and 6 listed as being in the vicinity of Whitefish. This includes 4 new territories with data that is still considered tentative (Montana Peregrine Institute http://www.montanaperegrine.org/Peregrine-Watch.html obtained May 2015), but represents a large increase in reported territories in the last 10 years.

They typically nest in a scrape on cliff ledges near lakes or major rivers and prey upon birds by diving in the air. Adult falcons demonstrate a high degree of breeding fidelity and are known to reuse the same cliff nest site for several decades (USFWS 2003). Nesting habitat is created by geologic factors and has not changed significantly since populations crashed. Habitat for bird species that peregrines prey upon is diverse and generally supports a high diversity of bird species.

Courtship, nesting and fledging generally occur between February 1 and mid-August. Falcon nests are generally placed in areas where concentrated human activities do not occur. Human activities within ½ mile of an active nest site have the potential to impact falcons during the nesting period, depending on the type of activity and the distance. Disturbance near active nests can displace individuals and cause nest abandonment (Hamann et al. 1999). Peregrine populations have recovered with human activities currently occurring on NFS lands.

The affected environment describes key ecosystem characteristics associated with a species. The key stressors section which follows provides a foundation for the alternative effects analysis and an understanding of which stressors the USFS has authority to manage. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are activities that might impact a species and its habitat if not managed or mitigated. Stressors that are outside of Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. These are considered under "Cumulative Consequences".

Key stressors under USFS control

Human Disturbance: Forest Service activities that may occur near peregrine falcon nesting habitat are mainly related to timber harvest (and associated roads), blasting, firefighting using helicopters, and human recreation activities (USFWS 1999). Peregrines are sensitive to some types of human disturbance, such as blasting and low altitude helicopter flights at nest sites, during the time periods when they are raising young.

Key stressors not under USFS control

Human activities: Activities that may affect peregrine populations that are not under the authority of the USFS or occur on other land ownerships include collection of young for falconry, illegal shooting, and collision with power lines, fences, or cars.Because peregrine falcons do not feed on road-killed animals, they are not as susceptible to vehicle collisions as bald eagles.

Environmental Contaminants: In the past, peregrine populations were in drastic decline as a result of DDT use. The USFS does not have control over pesticides used on private croplands. DDT has been banned in the U.S., but contaminants in their winter habitat can reduce peregrine reproduction or cause direct mortality.

Climate Change: Peregrine falcons are not believed to be sensitive to climate change. Although climate change may affect potential prey of peregrine falcons, they prey on a wide variety of other birds, so they would be likely to shift to species that become more abundant as the climate changes. They can move long distances to find food.

Summary of alternative consequences

Recovery of the species occurred during implementation of the existing forest plan. Plan components would support key ecosystem characteristics for peregrine falcons because plan components would limit disturbance at cliffs used as nesting sites during key time periods and would support diverse habitats for a wide variety of bird species to provide prey (as well as for other birds of prey).

Environmental consequences alternative A

The cliff nesting habitat of peregrine falcons is unlikely to be affected by management of NFS lands and the bird prey base would continue to be diverse under current management. The 1986 forest plan provided direction to do a biological evaluation prior to implementing national forest vegetation management activities within ¼ mile of nests or use of pesticides within 15 miles of nests and to apply the American Peregrine Falcon Recovery Plan (Appendix SS) during site specific analysis.

The 1986 forest plan also stated that the following guidance would be applied to activities that may affect the peregrine falcon:

- Prohibit disturbance-causing activities such as road construction, logging and seismic exploration using explosives within ½ mile of active peregrine falcon nests during the nesting period; February 1 through August 1.

Environmental consequences alternatives B, C, D

As discussed under "Species Associated with Cliff, Cave, and Rock Habitats" and the "Watershed, Riparian, and Aquatic Resources", key ecosystem characteristics described in the affected environment would be supported by implementation of plan components. Plan components would maintain or improve feeding habitat and promote a diversity of prey species. In addition, species-specific plan components included in all action alternatives would support the peregrine falcon by limiting activities known to disrupt nesting during the nesting season. FW-GDL-SOI-WL-04 states that activities within 0.5 mile of cliffs used as known, active nest sites should incorporate measures to avoid or mitigate impacts from February to Mid-August.

Cumulative consequences

Because peregrine falcons tend to nest at low elevations along rivers and lakes that are heavily used by people, increases in population and recreation use of the large rivers and lakes where peregrines nest could increase human disturbance. However, because peregrines often nest in places that are inaccessible to people, this is expected to have a minor effect. There is no known rock climbing in areas of the Forest with peregrine nests. Peregrine falcon nesting territories have increased with existing levels of human use.

Federal and state water quality laws protect water bodies from contaminants that could affect the food chain of the peregrine falcon. MFWP regulates falconry and enforces penalties for illegal shooting or poisoning of peregrine falcons. MFWP also works with state and federal highway departments to ensure cliffs near highways are not impacted by highway construction.

In summary, the cumulative effects of proposed management actions on the Forest, in the context of all lands of the larger landscape, contribute to the ecological integrity of cliff and rock habitats that support mountain goats. This would be accomplished by forestwide plan components for cliff, cave and rock habitats as well as forestwide plan components to reduce disturbance to mountain goat kidding and winter concentration areas. Mountain goat habitat is limited by geology, but is distributed across all Forest GAs except the Salish Mountains GA. While the Forest does not have authority over all stressors that may affect mountain goats, the Forest contributes to the ecological conditons that support them.

Wildlife associated with persistent grass, forb, shrub habitats

Introduction

There are about 175 wildlife species on the Forest that use grass/forb/shrub habitats to meet at least some of their needs on a seasonal basis. The Forest manages a small fraction of persistent grass/forb/shrub habitats compared with surrounding lands (e.g. CSKT tribal lands or the Lewis & Clark/Helena NF), with only 5% of the Forest providing this habitat. As a result, many species that are known as grassland species (Casey 2000) or depend upon grass/forb/shrub habitats year-round, are not yearlong residents on the Forest. For example, bighorn sheep are not year-round resident on NFS lands of the Forest, but are observed feeding on grassy slopes in the Bob Marshall Wilderness Complex along the boundary of the Lewis & Clark/Helena NFs during the summer months.

Key indicators for analysis

In addition to the indicators in the “Vegetation” section of chapter 3, the indicators used to focus the analysis and disclose relevant environmental effects were developed after considering key stressors, public comments, and issues identified during scoping.

- Activities that maintain or improve native species composition in persistent grass/forb/shrub habitats**.**

Affected environment

On the Forest, much of the persistent grass/forb/shrub habitat occurs in small patches or stringers surrounded by coniferous forest. Examples of key ecosystem characteristics for species associated with this habitat are abundant grasses, forbs and shrubs that provide foraging and nesting sites. Avalanche chutes occur on steep slopes and may persist for long periods of time due to the snow repeatedly sliding and uprooting coniferous trees. Avalanche chutes often have dense tall shrubs used by grizzly bears for cover as well as a wide variety of plants used for food. Great gray owls hunt in wet or dry meadows, and pastures. Access to suitable hunting meadows may restrict population densities (Hayward and Verner 1994). Elk also forage in wet meadows, as well as on open grassy slopes. Fire, fire suppression, and invasion or treatment of noxious weeds are the primary processes or activities that have affected persistent grass/forb/shrub habitats on the Forest. There are no specific species discussed in this section, because most of the species that use persistent grass/forb/shrub habitats on the Forest are also associated with transitional habitats created when fire burns coniferous forest, discussed in the wildlife section on “Coniferous Forest in a Variety of Successional Stages” below.

The affected environment section describes key ecosystem characteristics. The key stressors section which follows provides a foundation for the alternative effects analysis and an understanding of which stressors the USFS has authority to manage. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are activities that might impact a species and its habitat if not managed or mitigated. Stressors that are outside of Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. These are considered under “Cumulative Effects”.

Key stressors under USFS control

<u>Non-native plant invasion</u>: Key stressors on persistent grass/forb/shrub communities on all lands are primarily related to invasion of non-native plant species. The Forest can take action to control non-native plant invasion on NFS lands.

Key stressors not under USFS control

<u>Non-native plant invasion</u>: Because seeds of non-native plants can easily be carried to NFS lands from other lands by wind, water, motorized and non-motorized vehicles, machinery, livestock, wild animals and people, control of this stressor requires a cooperative effort.

Summary of alternative consequences

Plan components would support key ecosystem characteristics because ecosystem processes (e.g. fire, avalanches) would maintain or create these habitats, vegetation management activities would create or maintain transitory grass/forb/shrub habitats, and the ecological integrity of grass/forb habitats would be supported by controlling invasive weeds.

Environmental consequences alternative A

The 1986 Forest plan does not have specific objectives to treat grass/forb/shrub habitats with prescribed fire or to treat a certain number of acres to reduce the density or spread of invasive weeds in grass/forb/shrub habitats. However, since the need has been recognized, these activities have been accomplished under the guidance of a specific invasive species EIS and numerous cooperative projects between the Forest, the counties, the state, and non-government organizations.

Environmental consequences alternatives B, C, and D

Alternatives B, C, and D benefit wildlife by having specific plan components to maintain or improve the composition of grass/forb/shrub habitats, to control invasive weeds, and to limit livestock grazing (also see the section of Chapter 3 on Non-Native Invasive Plants/Noxious Weeds and Livestock Grazing). Plan components benefit wildlife species associated with this ecosystem/key ecosystem characteristic. Desired condition FW-DC-TE&V-10 addresses diversity of grass/forb/shrub habitats.

With alternatives B, C, and D, desired conditions for grazing (FW-DC-GR-01, 02, 03) would benefit wildlife. Standard FW-STD-GR-05 specifies that new cattle grazing allotments cannot increase above the baseline in the grizzly bear PCA, which would limit the risk of spread of non-invasive plant species and benefit wildlife because the area covered by cattle allotments would not increase (the Forest does not have sheep grazing allotments).

With alternatives B, C, and D, plan components for non-native, invasive plants (FW-DC-NNIP-01, 02, and 03; FW-GDL-NNIP-01; FW-OBJ-NNIP-01) would also benefit wildlife species by controlling invasive species with integrated pest management approaches by treating 12,000 to 16,000 acres over the expected 15 year life of the plan, to contain or reduce non-native invasive plant density, infestation area, and/or occurrence. Over the life of the plan, a total of 1,500 to 5,000 acres of persistent of grass/forb/shrub plant communities would be treated to improve conditions for native plant establishment and growth and reduce non-native plants (which could also include use of prescribed fire)(FW-OBJ-TE&V-04).

Cumulative consequences common to most species associated with grass/forb/shrub habitats

This section summarizes activities and effects that are common to most species associate with grass/forb/shrub habitats. The Forest has very limited persistent grass/forb/shrub habitats because most of the forest gets sufficient precipitation to support trees.

Grass/forb/shrub habitats have shifted from where they occurred historically and will continue to shift over time as human settlement and climate conditions change. In the distant past, prescribed fire was used as a tool by Native Americans to create and sustain persistent grass/forb/shrub habitats, especially in valley bottoms in the warm-dry and warm-moist biophysical settings where some animals spent the winter. Subsequently, some Flathead Valley lands were converted to human developments or agricultural lands. If properly managed, livestock grazing is compatible with maintenance of grass/forb/shrub habitats. Some wildlife species have adapted to these changes and now use agricultural lands that provide grasses and forbs. Even where forest lands were not permanently converted to developments, wildfire exclusion has resulted in succession of grass/forb/shrub habitats, especially adjacent to where human developments occur.

It is unlikely that climate changes would reduce precipitation for a prolonged enough period of time to convert forest lands to grasslands, but wildfires are likely to play a dominant role in the future. In the future, if wildfires burn the same acreage more than one time in rapid succession, trees (even lodgepole pine trees, which produce seed at a relatively young age) may not grow old enough to produce seed between burns and grass/forb/shrub areas may persist for longer periods of time. This occurred in some areas of the Forest after wildfires in 1910, 1919, and 1926.

In summary, the cumulative effects of proposed management direction on the Forest, in the context of all lands of the larger landscape, contribute to the ecological integrity of persistent grass, forb, and shrub habitats. This would be accomplished by plan components to support natural ecosystem processes that create these habitats and to restore habitats that have been affected by invasive species. While the Forest's ecological capacity to provide persistent grass, forb, and shrub habitat is limited by topographic and climate factors, this habitat would be supported on NFS lands.

Wildlife associated with high-elevation habitats including persistent snow

Key indicators for analysis

The indicators used to focus the analysis and disclose relevant environmental effects were developed after considering key stressors, public comments, and issues identified during scoping.

Affected Environment

Most ecosystems that occur at high elevations are not substantially altered from historical conditions. Historically, these ecosystems have been affected by high winds, extreme temperatures, avalanches, unstable rock, poorly developed soils with low organic matter, and/or high UV radiation levels. Snow retention provides moisture for plants during the growing season, as well as habitat. Examples of species associated with high elevations (that have not been addressed in other sections of the DEIS) include the wolverine, American pipit, golden-mantled ground squirrel, white-tailed ptarmigan, and gray-crowned rosy-finch. Examples of key ecosystem characteristics of high elevation habitats on the Forest are that they have colder temperatures, more snow cover than lower elevations, and snow that persists into the spring. Wildlife species associated with this habitat may use the accumulated snow for nesting, denning, or shelter from the wind and cold. Some species dig beneath the snow for foraging.

For example, the white-tailed ptarmigan and gray-crowned rosy-finch are restricted to the highest elevations in wilderness areas on the Forest during the breeding season. Habitat for the white-tailed ptarmigan is alpine locations; moist vegetation near snowfields and streams and willow-dominated (*Salix* spp.) plant communities are present in all areas heavily used by ptarmigan in summer. In winter, ptarmigan occupy rocky areas and patches of krummholz (stunted and wind-deformed) trees (Choate 1963; Scott 1982). Gray-crowned rosy-finches nest in abandoned buildings, crevices, cliffs, and talus among glaciers or persistent snowfields and forage in barren, rocky, or grassy areas adjacent to the nesting sites.

One species, the wolverine, is discussed below in order to help display differences in effects of alternatives, but effects to other species associated with these habitats may be similar. In addition to coarse filter plan components, there may be species-specific plan components to address the needs of this species. The first part of this section describes key stressors and consequences that are applicable to high elevation habitats with persistent spring snow on the Forest and then key stressors and consequences specific to the wolverine are described. For detailed information on the population and life history of these species refer to the Montana Field Guide (http://fieldguide.mt.gov) and the Montana Partners in Flight Bird Conservation Plan (Casey 2000).

The affected environment section describes key ecosystem characteristics. The key stressors section which follows provides a foundation for the alternative effects analysis and an understanding of which stressors the USFS has authority to manage. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are activities that might impact a species and its habitat if not managed or mitigated. Stressors that are outside of Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. These are considered under “Cumulative Effects”.

Key stressors under USFS Control

Land Management: On the Forest, there have been few stressors to species associated with high elevation habitats and persistent spring snow because the majority of this habitat is in protected areas on NFS lands including wilderness (figure 1-01) and inventoried roadless areas (figure B-02) where the main activities that occur are related to dispersed recreation.

Key stressors not under USFS Control

Climate change: Downscaled climate models are used to predict effects of climate changes. There is a level of uncertainty with all models, but the level of uncertainty associated with winter temperature and precipitation is higher than for summer temperature and precipitation. For this DEIS, we used a compilation of climate change effects published for the Northern Region Adaptation Partnership (NRAP 2015), summarized in Chapter 1.

Summary of alternative consequences

The USFS does not control the amount of high elevation habitat that provides persistent spring snow. However, plan components would support key ecosystem characteristics for species associated with this habitat. Species associated with this habitat live at the highest elevations in existing Wilderness where there are generally few, if any, threats to habitat. There are no differences in existing Wilderness for any alternative. There are differences in alternative with respect to suitability for motorized use (figures B-03-05). Over-snow motorized use is discussed in detail in the section on wolverines which follows.

Cumulative consequences common to most species associated with high elevation habitats

This section summarizes activities and effects that are common to most species associated with high elevation habitats.

During the summer and fall, non-motorized trails at high elevations receive use by hikers, horse-back riders, and mountain bikers. Some forest roads access high elevation habitats, but some forest roads as well as some high elevation wheeled motorized trails have been closed in recent decades, making some areas less accessible to people. Motorized over-snow vehicle use has been limited since implementation of the winter use provisions of the Flathead’s Winter Motorized Recreation Plan Amendment 24 (USDA FS 2006). This decision identified areas and routes open and closed to motorized over-snow use. Amendment 24 currently allows motorized over-snow use on about 31 percent of the Flathead National Forest outside of Wilderness areas and it is not allowed on about 69 percent of the Forest. Many high elevation areas are open to motorized over-snow vehicle use only from December through March, but the A24 Decision included four “late-season” areas where motorized over-snow vehicle use is allowed during April and May (USFWS 2006, appendix A)(see grizzly bear section of chapter 3 for more details).

Glacier National Park, the Confederated Salish and Kootenai Tribal wilderness (adjacent to the Forest) and state lands managed by Montana Department of Natural Resources and Conservation (in and adjacent to the Forest) also provide high elevation habitat with persistent spring snow. Glacier National Park and the Conferederal Salish and Koontenai wilderness is closed to motorized over-snow use. Montana Department of Natural Resources and Conservation lands occur on portions of the Stillwater State Forest in the Salish GA, the Coal Creek State Forest in the North Fork Flathead River GA, and the Swan State Forest in the Swan Valley GA and are generally open to motorized over-snow use.

Ski areas also occur in high elevation habitats with persistent spring snow. Whitefish Mountain Resort has operated on NFS lands under special use permit -- as a ski area since the 1940s, but as a year-round resort since the 1980s. This area has the highest level of year-round use of any recreation area in persistent snow and high elevation habitats on the Forest. The Blacktail Mountain Ski Area also operates on NFS lands under a special use permit, but it is not operated as a year-round resort.

There are no mineral or energy developments in high elevation habitats on the Forest. No surface occupancy applies to mineral development in Wilderness and the Forest has low potential for mineral development elsewhere, so high elevation habitats are not expected to be impacted by mineral development.

Habitat conditions associated with snow that persists through the spring were not a concern in the past, but have become a concern in recent decades due to changes in timing of snowmelt that have been documented worldwide and in areas of Glacier National Park (adjacent to the Forest) over the last century (see Forest Assessment, 2014, for more details). The most important climate change predictions for this group of species are that the mean monthly minimum temperature (spring and autumn) and the mean monthly maximum temperature (winter) may rise above freezing. Seasonal precipitation is projected to be slightly higher in winter and spring. The combination of these two factors may be beneficial, neutal, or detrimental, depending upon whether more precipitation falls as rain or as snow, and at what elevations. If the temperature in winter or spring rises above freezing for a more prolonged period of time, snow does not persist as long. However, if increased precipitation falls as snow at high elevations, this could offset the increased melting.

In summary, the cumulative effects of proposed management direction on the Forest, in the context of all lands of the larger landscape, contribute to the ecological integrity of high elevation habitats, including those with persistent spring snow. This would be accomplished by plan components to limit development and the risk of human disturbance to wildlife associated with this habitat. While the Forest’s ecological capacity to provide persistent snow is limited by topographic and climate factors, this habitat is distributed across all geographic areas. While the Forest does not control all stressors to high elevation habitats, the ecological conditions that support species associated with this habitat would be provided on NFS lands.

Wolverine

When the Forest’s assessment was published (April 2014), the USFWS had published a proposed rule to list the North American Wolverine as a threatened distinct population segment (DPS) in the contiguous United States. However, on August 13, 2014 the USFWS withdrew its previous proposal (Federal Register / Vol. 79, No. 156 / Wednesday, August 13, 2014 / Proposed Rules). On April 14, 2016 the Court remanded the matter to the U.S. Fish and Wildlife Service for further consideration consistent with order CV 14-246-M-DLC (Consolidated with Case Nos.14-247-M-DLC and 14-250-M-DLC).

Key indicators for analysis

The public expressed an interest in this species during scoping. As described in the affected environment section below, wolverines are generally not affected by most activities occurring on the Forest, but some members of the public expressed concern about the potential impact of winter recreation activities and the effects of climate changes on wolverines. In addition to the indicators and effects of alternatives on habitat described under “Wildlife associated with high-elevation habitats including persistent snow”, the following species-specific indicator applies to the wolverine:

- Risk of human disturbance to female wolverines with young in areas of modelled wolverine maternal denning habitat.

Affected environment

Population, life history, habitat, and distribution: Wolverines are year-round residents across most of Alaska, British Columbia, and the northern portion of the other Canadian provinces. The southern portion of the species' range extends into high-elevation alpine portions of Washington, Idaho, Montana, Wyoming, California, and Colorado They occur at low densities, are difficult to detect, range widely, and inhabit remote and rugged landscapes away from human populations, so research on wolverines is challenging (Idaho Department of Fish and Game 2014). Wolverine populations in Montana were heavily trapped in the early 1900's and were near extinction by 1920. However, numbers increased in the western part of the state from 1950 to 1980 (Hornocker and Hash 1981). State fish and wildlife agencies in 4 states, including Montana, have recently initiated a cooperative, coordinated wolverine monitoring project.

The Forest lies within the Northern Rocky Mountains area assessed by the USFWS. Population growth and expansion has been documented in the North Cascades and Northern Rocky Mountains (Federal Register / Vol. 79, No. 156 / Wednesday, August 13, 2014 / Proposed Rules). According to the USFWS (2014), "wolverine records from 1995 to 2005 indicate that wolverine populations currently exist in the northern Rocky Mountains and that the bulk of the current population occurs here. Within the area known to currently have wolverine populations, relatively few wolverines can coexist due to their naturally low population densities, even if all areas were occupied at or near carrying capacity. Given the natural limitations on wolverine population density, it is likely that historic wolverine population numbers were also low." (Federal Register / Vol. 79, No. 156 / Wednesday, August 13, 2014 / Proposed Rules).

On the Forest, studies or research on wolverine occurred in the 1980s (Hornocker and Hash 1981). Hornocker and Hash conducted telemetry research on 24 individual wolverines over a five year period within a study area making up about 1300 km^2 of the Flathead National Forest. Their study area was primarily made up of the South Fork of the Flathead drainage and secondarily portions of the Sun, Swan, and Middle Fork of the Flathead River drainages. About one-half the study area was used for timber harvest and recreational purposes while the other half was Wilderness. Hornocker and Hash found that wolverines were at relatively high densities in the South Fork of the Flathead River drainage and they concluded the population was stable (Hornocker and Hash 1981).

Current information for the Forest is based on: 1) reported trapping records, 2) non-invasive monitoring including remote cameras and DNA analysis of hair or scat, and 3) observations/sightings of either the species or tracks recorded in forest or state databases. No recent research that would estimate population levels has been conducted for wolverine on the Forest. The Forest and other cooperators detected a minimum of 13 individual wolverines within Forest geographic areas (based upon genetic analysis of samples collected during non-invasive carnivore monitoring in areas accessible by snowmobile from 2012-2015 (see planning record exhibit V-10).

Wolverines are a wide-ranging species with populations that fluctuate in response to prey availability, juvenile dispersal, and mortality of adult females. Research on wolverines in Glacier National Park (adjacent to the Forest) has occurred in the last decade (Copeland and Yates 2006, Squires et al. 2007). Copeland and Yates found that wolverines were constantly on the move, with adult female home ranges that averaged 55 mi^2. Adult males ranged over an even larger area, including lands outside the park, with home ranges that averaged 193 mi^2 (Copeland and Yates 2006). Prior to this study, not much was known about den sites of reproductive female wolverines in Montana because den sites of reproductive females are often in remote terrain that is very difficult to study. During the first 3 years of the study, data was collected for 19 wolverines and information about reproductive dens was obtained for two adult females that raised 4 offspring (kits). Females used 2-3 different dens prior to weaning of kits at 6-7 months of age. Abandonment of natal and maternal dens may be a preemptive strategy that may confer an advantage to females if prolonged use of the same den makes a den more evident to predators (Federal Register / Vol. 79, No. 156 / Wednesday, August 13, 2014 / Proposed Rules). Survival of young was low, even in the national park setting where trapping does not occur and where there is no motorized disturbance in winter or spring.

Genetic connectivity of wolverine “meta-populations” was raised as a concern by the public. The USFWS stated that the Northern Rocky Mountains portion of the North American Wolverine Distinct Population Segment (DPS) is thought to be the largest subpopulation and the most genetically resilient of the current subpopulations (Federal Register / Vol. 79, No. 156/Wednesday, August 13, 2014 / Proposed Rules). Persistent spring snow cover is also correlated with gene flow because this is where the wolverine’s within-home range movements and dispersal occurs year-round (Schwartz et al. 2009). Wolverines are known to make long-distance movements that are not impeded by topography (Copeland and Yates 2006, Squires et al. 2006).

Copeland and others defined snow persisting to mid-May and accumulating to depths greater than 5 feet as “persistent spring snow”, stating that this factor appears to be a requirement for denning by reproductive females. Copeland and others modelled persistent spring snow for 7 years from 2000-2006 (which was variable from year to year). Their model displays the number of years out of 7 that a GIS pixel was classified as snow (e.g. 7 years out of 7 versus 1 year out of 7). For the Glacier National Park study site (adjacent to the Forest), 93% of wolverine telemetry locations were in the spring snow coverage area. Data on denning female wolverines in the U.S. is limited. Copeland considered all known wolverine dens in Norway and Sweden to display preference, finding that areas with persistent spring snow 5, 6, and 7 years out of 7 were preferred (Copeland et al. 2011 figure 4). About 90% of the 62 known den sites in North America occurred in areas that had persistent spring snow for 5, 6, or 7 years out of 7 (Copeland, unpublished data *IN* Weaver 2014). Copeland and others found that reproductive dens were excavated in the snow and were on upper slopes in sparse timber beneath downed, woody debris. Dens are typically used through late April or early May. Kits gathered at rendezvous sites that were primarily in boulder, talus, and cliff areas (Copeland et al. 2010).

Wolverine year-round habitat use also takes place almost entirely within the area defined by deep persistent spring snow (Copeland et al. 2010). Year-round habitat is found at high elevations where rocky alpine habitats, glacial cirque basins, and avalanche chutes have food sources such as marmots, voles, and carrion (Hornocker and Hash 1981, Copeland 1996, Magoun and Copeland 1998, Copeland et al. 2007, Inman et al. 2007). Wolverines appear to rely on the cold and snow to cache carrion (Inman et al. 2011). Wolverines also travel through the area where snow persists through mid-May when dispersing and they minimize travel through low elevation habitat (McKelvey et al. 2011).

Wolverine habitat is also characterized primarily by low levels of human development (Hornocker and Hash 1981, Copeland 1996, Krebs et al. 2007 *IN* Federal Register / Vol. 79, No. 156 / Wednesday, August 13, 2014 / Proposed Rules). This negative association with frequent human presence is sometimes interpreted as active avoidance of human disturbance, but it may simply reflect the wolverine’s preference for cold, snowy, and high-elevation habitat that humans don’t often develop.

The USFWS assessed effects of a variety of human activities that can affect wolverines or their habitat.The USFWS stated that “few effects to wolverines from land management actions such as grazing, timber harvest, and prescribed fire have been documented. Wolverines in British Columbia used recently logged areas in the summer and moose winter ranges for foraging (Krebs et al. 2007, pp. 2189– 2190). Males did not appear to be influenced strongly by the presence of roadless areas (Krebs et al. 2007, pp. 2189–2190). In Idaho, wolverines used recently burned areas despite the loss of canopy cover (Copeland 1996). Management activities such as timber harvest and prescribed fire do occur in wolverine habitat; however, for the most part, wolverine habitat tends to be located at high elevations and in rugged topography that is unsuitable for intensive timber management. Wolverines are not thought to be dependent on specific vegetation or habitat features that might be manipulated by land management activities, nor is there evidence to suggest that land management activities are a threat to the conservation of the species" (Federal Register /Vol. 79, No. 156 /Wednesday, August 13, 2014 / Proposed Rules).

The USFWS also stated that it is unlikely that wolverines avoid the type of low-use forest roads that generally are found in wolverine habitat. Based on the best available science, the USFWS concluded that wolverines do not avoid human development of the types that occur within suitable wolverine habitat and that there is no evidence that wolverine dispersal is affected by infrastructure development (Federal Register /Vol. 79, No. 156 /Wednesday, August 13, 2014 / Proposed Rules).

Winter backcountry opportunities in the northern Rocky Mountains include snowshoeing, skiing, snowcat-skiing, heliskiing, and snowmobiling. In the Columbia Mountains of southern British Columbia, where winter recreation was widespread, both female and male wolverines were negatively associated with helicopters (Krebs et al. 2007). Heinemeyer and Squires are investigating winter recreation use in wolverine habitat in Idaho and stated that wolverines appear to tolerate many types of winter recreation in their home ranges. Wolverines have been documented to persist and reproduce in habitats with high levels of human use and disturbance including developed alpine ski areas and areas with motorized snowmobile use (Heinenmeyer 2012; Heinenmeyer and Squires 2013). Heinenmeyer and Squires stated, "Wolverines appear to tolerate winter recreation in their home ranges, including denning females. Based on our preliminary findings, potential wolverine habitats that have even high levels of winter recreation may support resident wolverines despite the potential human disturbance" (Heinenmeyer and Squires 2014). This suggests that wolverines can survive and reproduce in areas that experience human use and disturbance, however, there is uncertainty as to whether there is a threshold for the amount of disturbance that wolverines (particularly reproductive females) will tolerate within their home range.

Heinenmeyer and Squires indicated there may be increasing avoidance of winter recreation areas as the amount of an individual wolverine's home range affected by winter recreation increases. They also noted that the reproductive status of the females may affect their potential response to winter recreation, with reproductive females having higher movement rates when in a high recreation zone. However, Heinenmeyer and Squires stated that the response of individual wolverines to human disturbance is still being analyzed and is based on a small sample size. The authors don't expect to have results until the fall of 2016 (Heinemeyer and Squires, 2014).

On the Forest, there are approximately 1.7 million acres of modelled wolverine habitat (see figure 1-15), based upon the composite Inman/Copeland model (USFWS 2013). The majority of modelled habitat occurs in the Bob Marshall Wilderness complex in the South Fork and Middle Fork GAs, with lesser amounts in the Swan and Mission Mountain portions of the Swan Valley GA, as well as the Whitefish Range portion of the North Fork and Salish Mountains GAs. On the Forest, about 59% of year-round wolverine habitat is in designated wilderness and about 25% is in roadless areas, providing habitat where the risk of human disturbance is very low. In addition, restrictions on road and motorized over-snow vehicle use enacted through amendments 19 and 24 (1986 forest plan, as amended), provides additional habitat for wolverines with a low risk of human disturbance during the denning season (table 31).

Stressors under USFS control

Human Disturbance: Some commenters expressed concern about winter recreation activities in persistent spring snow habitat on NFS lands. There is scientific uncertainty about winter recreation and the amount of disturbance female wolverines will tolerate within their home range, but it is under study (USDI Fish and Wildlife Service 2013; Woods et al. 2014; Heinenmeyer 2015). Winter motorized access can indirectly affect accessibility during the trapping season.

Stressors not under USFS control

Climate change: The 2013 ruling listing the North American Wolverine as a proposed threatened species identified threats to the long-term persistence of the species. The primary threat was determined to be climate change. (USFWS 2013). The natural range of variability for persistent spring snow on the Forest is unknown.

Mortality due to trapping: MFWP has authority over wolverine trapping.

Highways: Wolverine mortality from collisions with vehicles has occurred, but at low levels. Wolverines use habitats that are not particularly conducive to roads so they do not usually come into contact with high-traffic volume roads except in those areas where highways cross over mountain ranges, usually major passes. Wolverines killed on roads in valleys between mountain ranges are likely the result of dispersal attempts by wolverines and appear to be rare occurrences (Federal Register / Vol. 79, No. 156 / Wednesday, August 13, 2014 / Proposed Rules).

Summary of Alternative Consequences

In order to assess the effects of alternatives on wolverine habitat, the Forest used two models, because there is scientific disagreement and uncertainty over available models and the appropriate scale for their use (e.g. range-wide, den site). For total wolverine habitat, we used the composite model adopted as best available science by the USFWS for wolverine habitat across the United States (USFWS 2013, 2014)(figure 1-15) which incorporated the work of two groups of scientists (Inman et al. 2011; Copeland et al. 2010). For effects on maternal denning habitat, we used the model developed by Copeland and others (2010).

As described in the “affected environment” section, research results suggest wolverines are generally tolerant of recreation activities (Heinenmeyer and Squires 2014). Thresholds for the amount of development or human recreation use that individual wolverines will tolerate in their home ranges is unknown, but is being investigated. Plan components would support key ecosystem characteristics for wolverines because about 59% of total modelled wolverine habitat on the Forest is in designated Wilderness and about 25% is in inventoried roadless areas with all alternatives, providing habitat where the potential for human disturbance is very low.

Modelled maternal denning habitat encompasses about 655,000 acres or 27% of all Forest lands (see figures 1-16 to 1-23, modelled wolverine maternal denning habitat). T able 31 displays consequences of alternatives (also see figures 1-16 through 1-23). The percentage of the Forest where motorized over-snow vehicle use would be suitable would not increase with alternatives A or B. The percentage would decrease from current by 8% with alternative C and increase by 1% with alternative D.

Table 30. Modelled maternal denning habitat by alternative with persistent spring snow (5, 6, or 7 years out of 7)

Over-snow use in modelled denning habitat with persistent snow 5, 6, or 7 years out of 7	Alternative A	Alternative B	Alternative C	Alternative D
Acres where motorized over-snow vehicle use is suitable	74,048	69,493	18,051	77,257
Acres where motorized over-snow vehicle use is not suitable	580,644	585,199	636,641	577,435
% of total where motorized over-snow vehicle use is suitable	11%	11%	3%	12%

As shown in table 31, alternative C would have the lowest percentage of modelled wolverine denning habitat where motorized over-snow vehicle use would be suitable, due to having the most recommended wilderness with the most restrictions on motorized over-snow use. Alternative D would have the highest percentage. Alternatives A and B both maintain the existing percentage, but shift where it is located on the Forest (see figures 1-16 to 1-23). Alternative B would change an area in lower Big Creek to suitable, but it is not in modelled maternal denning habitat. The area in Sullivan Creek that would become unsuitable is in modelled maternal denning habitat, resulting in a slight net decrease in modelled maternal denning habitat that is suitable for motorized over-snow use of about 4,500 acres. It is presently unknown how these changes would affect female wolverines with offspring, because thresholds for levels of human disturbance in areas of denning habitat are unknown at this time.

Environmental Consequences Alternative A

Amendment 24 (USFS 2006) designated specific routes and areas, as well as seasons, for motorized over-snow use as per §212.81 of the Travel Management Rule. There is new scientific information about effects of human disturbance which indicates that wolverines are generally tolerant of human recreation use, as described in the affected environment section. Plan components for motorized over-snow vehicle use would support key ecosystem characteristics for wolverines because activities which have a risk of disturbing reproductive females with offspring would be suitable on no more than 11% of modelled maternal denning habitat.

Environmental consequences Alternatives B, C, D

Plan components for motorized over-snow vehicle use would support key ecosystem characteristics for wolverines because activities which have a risk of disturbing reproductive females with offspring would be suitable on no more than 12% of modelled maternal denning habitat with alternative D, 11% with alternative B, and 3% with alternative C (see figures 1-18 to 1-23 and table 31).

For alternative B, guideline FW-GDL-REC-05 states “To maintain the quality of lynx habitat or wolverine maternal denning habitat (see figures B-14 and 1-12, or subsequent updates if available), there should be no net increase in miles of designated motorized over-snow vehicle routes or areas where motorized over-snow vehicle use would be allowed in lynx habitat or wolverine maternal denning habitat on NFS lands at a forestwide scale. Specific locations of routes or areas suitable for motorized over-snow vehicle use on the Forest may be shifted as long as it does not result in adverse impacts to the Canada lynx or wolverine (forest-specific modification that replaces NRLMD guideline HU G11, appendix F). For alternative D, the guideline would allow a net increase of 1%.

Cumulative Consequences

There is uncertainty on effects to wolverines from climate change which is associated with scale. At a region-wide scale, the preliminary Northern Region Adaptation Partnership risk assessment for the wolverine (NRAP 2015) states that there is no evidence that wolverines can persist in areas distant from extensive areas of spring snow, thus, adaptive capacity appears to be low. The authors estimated that the magnitude of effects would be low in 2030 and moderate in 2050, with a high likelihood of effects across all time periods. Across the northern region as a whole, losses of current levels of persistent spring snowpack are estimated to be around 30% by mid-century (NRAP 2015). McKelvey and others (2011) stated: “although wolverine distribution is closely tied to persistent spring snow cover (Copeland et al. 2010), we do not know how fine scale changes in snow patterns within wolverine home range may affect population persistence.” The USFWS concurred with this finding, stating, “an improved understanding of how microclimatic variation alters the habitat associations of wolverines at fine spatial scales is needed” (USDI FWS 2014).

At a more localized scale of the northern Rockies, potential effects of future climate changes on persistent spring snow is less certain**.** According to the models, northern Montana (including the Forest), the southern Bitterroot Mountains and the Greater Yellowstone Ecosystems retain significant spring snow in the next 50 years whereas central Idaho is projected to lose significant spring snow (McKelvey et al. 2011). There are variations in climate models, but models generally indicate earlier snowmelt in the Northern Rockies in the future, a pattern that has been ongoing since at least the 1950s. While wolverines are known to spend the majority of time at high elevations, the degree to which earlier snowmelt may affect wolverines and connectivity of meta-populations is also uncertain. Wolverines are a highly wide-ranging species and recent research in GNP has demonstrated that habitat connectivity between Glacier National Park, the Forest, and Canada currently supports wolverine movement (Copeland and Yates 2006).

Some members of the public expressed a concern about the cumulative consequences of climate change combined with recreation activities. In areas open to motorized over-snow vehicle use, the amount of use has increased over the last few decades because technical advancements in motorized over-snow vehicles are occurring and the human population in the Flathead Valley has grown. Backcountry skiing has also increased in popularity (see recreation section of Chapter 3 for more details). Glacier National Park provides over 1 million acres (much of it at high elevations) that is closed to motorized over-snow vehicle use. In combination with wilderness areas on the Forest to the south, there are over 2 million acres of habitat available to wolverines where there is no motorized over-snow vehicle use allowed and where ungulates are present to provide sources of carrion. In addition, wolverine movement is not impeded by topography. Research in Glacier National Park has shown that they can rapidly ascend very steep terrain with deep snow when they move, so it is likely that they can avoid people if they choose to.

Whitefish Mountain Resort is in an area of persistent spring snow. Adjacent areas are modelled as maternal denning habitat, but it is unknown whether a wolverine would den there due to the high level of human disturbance. In the past decade, skiers riding the lift observed a wolverine as it fed on carrion. Blacktail Mountain ski area has a small amount of modelled maternal denning habitat, but because it is small and widely separated from other areas of wolverine habitat, it is unknown whether it receives wolverine denning use. As discussed in the affected environment section, a wolverine was observed at Whitefish Mountain Resort even when high numbers of people were present, because carrion was present.

Wolverine trapping harvest during the 30 years prior to 2007 was considered stable, with a statewide average of 10.5 wolverines taken annually during this time period (MFWP 2009). Then, based on research findings by Copeland and others (Squires et al. 2007), wolverine trapping quotas were adjusted downward for the two large ecosystems in the state; the Northern Continental Divide Wildlife Management Unit (WMU 1) and Greater Yellowstone (WMU 3). Further analysis tied to genetic make-up of the Montana wolverine population, the issue of maintaining population connectivity, and recognizing the core population areas of three major ecosystems (now including central Idaho wilderness area) led to additional regulation changes in 2008. These adjustments included delineating four WMUs and reducing quotas to a statewide total of five animals, with a central Montana WMU quota of 0, to promote population connectivity among the three major ecosystems in the state where harvest is allowed (MFWP 2009). In December 2012, a state district court judge in Helena granted a temporary restraining order that blocked the opening of Montana's 2012–13 wolverine trapping season and it remained closed with a quota of "0" in 2013–14 and 2014-15. The future of wolverine trapping is unknown. The Forest is within wolverine management unit 1 (WMU 1) (northwest Montana), which had a quota of three wolverines (with a maximum of one female) in 2010 and has had a quota of 0 since then (MFWP Furbearer Trapping Regulations 2014-15). Since trapping was suspended in 2011, there has been one wolverine trapped accidentally (T. Thier MFWP pers. comm. 2016). Glacier National Park, encompassing about a million acres adjacent to the Forest, is closed to trapping. Any cumulative effects to the wolverine resulting from trapping and winter recreation access on all lands are highly uncertain at this time, but investigations are ongoing. Management on the Forest has supported wolverine populations in the past and is expected to continue to do so in the future.

With respect to connectivity and highways on the Forest, there is one high-elevation, paved highway along the border between the Forest and Glacier National Park. Since 2011, there have been two wolverines killed by vehicles in MFWP Region 1 (T. Thier pers. comm. 2016). Squires and others concluded that wolverine movements are unpredictable and are not well suited for planning structural highway mitigation projects. They suggested that connectivity for wolverines may be facilitated by limiting permanent developments through conservation easements and land purchases (Squires et al. 2006). The Forest and Montana DNRC recently completed the Legacy land acquisition in the Swan Valley GA of the Forest. This acquisition and other conservation easements on private lands may benefit wolverines in the future by limiting the density of permanent human developments, facilitating movement between mountain ranges.

Wildlife associated with coniferous forest habitats in a variety of successional stages

Introduction

Coniferous forests are the dominant land cover on the Forest and species associated with coniferous forest habitats are very diverse, consistent with the diverse composition and structure of coniferous forests as they change over time. There are hundreds of wildlife species on the Forest associated with these coniferous forests and their key ecosystem characteristics (see appendix D). Because wildfire, insects, and disease have historically created a mosaic of habitats that range from young, open forest with shade-intolerant conifer species to dense, old forest with shade-tolerant species, most of the associated wildlife species are adapted to a complex of successional stages and species compositions that are within the historic range of variability. This complex of successional stages meets their needs for nesting or denning, foraging, resting, cover, and connectivity. For example, the Goshawk nests in large trees but feeds in forested areas with an open understory providing grasses, forbs, and shrubs. White-tailed deer spend much of the winter at lower elevations in mature coniferous forests that have sufficient canopy trees to intercept snow, but forage in all successional stages throughout the year, including openings. Marten prefer coniferous forest cover, but prey on a wide variety of small mammals, including those that have high densities in forest openings. Some species, such as the Clark's nutcracker, are associated with particular tree species for nesting and foraging (e.g. whitebark pine and Ponderosa pine) that are uncommon on the Forest. The Canada lynx is associated with boreal forests in the cool-moist and cold biophysical settings, as well as a structural aspect of coniferous forests, understory density. In contrast, grizzly bears are habitat generalists that are associated with all coniferous forest types, as well as hardwood forests and non-forest habitats found on the Forest.

Fire and regeneration harvest in coniferous forest creates early successional habitat on a temporary basis. There are about 175 species on the Forest that use early successional grass, forb, and shrub habitats for feeding or breeding during all or portions of the year (See Appendix D of Revised Forest Plan). Transitory grass/forb/ and shrub habitats on the Forest may be a successional stage of coniferous forest development that lasts 10-20 years or so following fire or timber harvest, or may persist for several more decades on harsh sites with slow forest growth, or in areas where wildfires have burned the same area more than once in a short period of time.

Eight of the species associated with coniferous forest habitats are specifically addressed as examples in this section in order to help display differences in effects of alternatives, but effects to other species associated with these habitats may be similar. These species are the Clark's nutcracker (SCC); white-tailed deer, elk, mule deer, moose, gray wolf, marten, and goshawk. For detailed information on the population and life history of these species refer to the Montana Field Guide (http://fieldguide.mt.gov) and the Montana Partners in Flight Bird Conservation Plan (Casey 2000). In addition to coarse filter plan components, there may be species-specific plan components to address species needs.

Because some wildlife species associated with coniferous forests have specific habitat requirements for very large trees or snags, whereas others are associated with burned forests or use smaller snags, the wildlife analysis that follows is split into sections based upon key characteristics of coniferous forests: 1) coniferous forests in a variety of successional stages, 2) old growth habitat, and very large trees >20"dbh; 3) burned forest and snags <20" d.b.h. Species such as the pileated woodpecker and fisher are associated with forest structure including snags and downed wood in the very large size class for nesting, resting, feeding or denning. Species such as the black-backed woodpecker are associated with the abundance of dead trees of a wide range of sizes as well as abundant wood-boring insects found in recently burned forests (discussed in separate sections below). Wildlife species that are currently listed as Threatened or Endangered are addressed in a separate section below.

Key indicators for analysis of most wildlife species associated with coniferous forest habitats in a variety of successional stages

Coniferous forest biophysical settings (figures B-07 to 13) and key ecosystem characteristics of coniferous forests, listed below, are discussed in detail in the vegetation section of chapter 3.

- Vegetation composition: vegetation dominance type and tree species presence
- Forest size class and very large tree component: associated with tree d.b.h. (diameter of the tree at breast height, 4.5 feet from ground level)
- Old growth forest: as specifically defined by Green and others (1992 with errata)
- Forest density: associated with coniferous tree canopy cover percent
- Snags and downed wood: snags per acre and tons per acre for downed wood
- Landscape vegetation pattern: characteristics of forest patches (size classes/successional stages)

In addition to key indicators addressed in the vegetation section 3.3 of the DEIS, the following indicators are important for the wide variety of wildlife species associated with coniferous forest habitats. The indicators were developed after considering key stressors, public comments, and issues identified during scoping. In addition, wildlife connectivity applies to multiple species and is discussed below.

Affected environment

Coniferous forest habitats make up close to 2 million acres on the Forest (Assessment 2014). As discussed in the Forest's Assessment, acres harvested reached a peak in the 1970's and have declined since, with a cumulative total of about 394,000 acres (20% of the coniferous forest acres) affected by commercial timber harvest through 2012 (see table 112 in the assessment for more details). In contrast, wildfires burned very few acres from 1940-1980, and reached a peak of about 450,000 acres in the first decade of 2000, a decade when about 23% of the coniferous forest acres burned (see section 3.8.8 for more details). The areas burned in the 2000s included nearly 69,000 acres of forest that had been harvested in the decades prior to the fire. Planting of tree seedlings within areas disturbed by fire or within regeneration harvest units has occurred across approximately 136,000 acres (about 5.6%) of Forest lands since 1950. About 61,000 of these planted acres were accomplished from 1990 to 2013. Planting is usually conducted for the purpose of establishing desired tree species on a site where natural regeneration is not expected to be sufficient and to restore species which have been affected by introduced diseases, such as white pine blister rust.

Because of this history, forestwide requirements (such as the Roadless Area Conservation Rule or vegetation standards adopted for recovery of the Canada lynx), and anticipated budgets, there are minor differences in the amount of timber harvest that is expected to occur over the life of the plan at a forestwide scale, as discussed below (see Vegetation and Timber sections of Chapter 3 for more details). The primary differences in alternatives are localized differences in the type and rate of timber harvest, the amount of prescribed burning, and the pattern of these activities on the landscape (for effects of roads, human development, and motorized recreation in coniferous forests see the grizzly bear section 3.7.5 and volume 3, chapter 6).

The USFS used the SIMPPLLE and Spectrum models to assess the effects of alternatives over the next 5 decades. The SIMMPPLE model has associated fire suppression logic and the SPECTRUM model is constrained by anticipated budgets and timber suitability (see Vegetation-Terrestrial Ecosystem and Timber sections of chapter 3 for more details). Results, as they relate to wildlife, are summarized in the following sections. In addition, Ecosystem Research Group (ERG) modelled effects of alternatives for select species associated with coniferous forest habitats in a variety of successional stages including the marten, goshawk, elk, moose, and white-tailed deer. The effects of alternatives on most species associated with coniferous forests are described first, followed by effects to specific species.

The affected environment section describes key ecosystem characteristics. The key stressors section which follows provides a foundation for the alternative effects analysis and an understanding of which stressors the USFS has authority to manage. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are activities that might impact a species and its habitat if not managed or mitigated. Stressors that are outside of Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. These are considered under “Cumulative Consequences”.

Key Stressors under USFS control

On NFS lands, timber harvest and associated road access, prescribed fire, wildfire, thinning, and planting can affect the quantity and quality of wildlife habitats. Fire suppression can alter historic stand structure and reduce the amount of forage for some species. These activities can also affect habitat connectivity. Habitat connectivity provided by forest cover is discussed following the section on marten.

Key Stressors NOT under USFS control

The same stressors as above, but on lands that are not managed by the USFS.

Summary of alternative consequences

Plan components would support key ecosystem characteristics associated with coniferous forest habitats. These habitats are constantly changing due to processes such as wildfire, insects or disease, and forest succession as well as timber harvest, thinning and planting. About 1.4 million acres of the Forest are lands that are not suitable for timber production because they are in existing wilderness (figures 1-01) or are in inventoried roadless areas (figure B-02) which are not suitable for timber production under the 2001 Roadless Area Conservation Rule. There are additional lands which are not suitable for timber production due to other technical or legal reasons or because timber production is not compatible with the desired conditions and objectives established by the plan alternatives. As a result, there is 13-22% of the Forest that is suitable for timber production (refer to Timber section of the EIS, and to figures 1-7 through 1-10) under any alternative. In addition, on lands suitable for timber production, there are forestwide limitations which were factored into modelled timber outputs. The end result is that differences in alternatives relative to consequences of timber harvest are relatively small and localized, as described below (see “Forest Products – Timber” section of DEIS Chapter 3, and to appendix 2 for more details).

To compare alternatives, management areas in the existing forest plan were grouped into the management area categories used in the revised forest plan. Timber harvest is not allowed in MA1a (Wilderness). Outside of RHCAs/RMZ's, coniferous forests in MAs 6b and 6c, some MA 7 areas, and the Miller Creek Demonstration Forest (MA 4b) are suitable for timber production. The MA4b area does not change with any alternative and the MA7 areas that are suitable for timber production do not change to unsuitable under any alternative, so the discussion of effects will focus on MA6 a, b and c. Other MAs are not suitable for timber production, but timber harvest may be allowable under certain conditions (see section of Chapter 3 on Forest Products- Timber for more details).

The expectation is that there would be the most intensive timber harvest in MA6c areas over time. Alternatives A and D have the highest (and very similar) number of acres in MA6c, followed by alternative B. Alternative C has the lowest number of acres in MA6c. With MA6b, the rate or intensity of timber harvest would not be as great as with MA6c in order to meet other resource objectives. For example, there might be more commercial thin or group selection harvest in MA6b areas and less regeneration harvest, or a slower rate of regeneration harvest. Alternative B has the highest number of acres in MA6b, followed by alternatives A and C (which are very similar in acreage) and then D. The expectation is that there would be the least intensive timber harvest in MA6a areas over time, because this MA would not have regulated timber harvest. Alternative C has the most acres of MA6a, alternatives B and D have very similar amounts, and alternative A has very little.

With alternative A, regeneration harvest would be limited to 40 acre patches in most instances, with distinct edge along boundaries of harvested and unharvested areas, and low canopy cover in harvest units. Limitations on distance to cover would create numerous, small patches of habitat and would limit regeneration harvest until adjacent areas recover. This pattern would benefit wildlife species associated with early successional forests and edge, but would not benefit wildlife species associated with interior forest habitats (see individual species discussions below). Timber harvest would occur in forest stands in the cool-moist biophysical setting if they are in in the wildland-urban interface or are outside the wildland-urban interface, but in a stem exclusion condition (see individual species discussions below). Alternative A has no prescribed fire use to meet desired conditions for vegetation, although prescribed fire is used to meet wildlife objectives in some areas, such as big game winter habitat.

With alternative B, more group selection harvest, as well as more commercial thin harvest, would be expected to occur and could exceed 40 acres in size. Prescribed fire also plays a strong role in achieving desired conditions under alternative B. Greater use of commercial thinning, group selection harvest, and prescribed fire would maintain more cover in the upper canopy and create more of a mosaic of understory vegetation, while increasing grasses/forbs/ and shrubs. This pattern would create less habitat for species associated with early successional forests and edge than alternative A, but would benefit some of the wildlife species associated with higher canopy cover or a mosaic of patches (see individual species discussions below). Timber harvest would occur in forest stands in the cool-moist biophysical setting if they are in in the wildland-urban interface or are outside the wildland-urban interface but in a stem exclusion condition (see individual species discussions below).

Alternative C has more acres in MA6a than A, B, or D. Alternative C would be similar to B in terms of timber production and prescribed fire use on MA6b and 6c lands, but alternative C has less acres of 6b and 6c combined than B. While Alternative C also has more recommended wilderness (MA1b) than alternatives A, B or D, (figures 1-01 to 04, and appendix 5) most of the areas recommended for wilderness are currently designated as inventoried roadless areas (figure B-02), which are not suitable for timber production, so timber harvest effects are minor. With alternatives A, B, and D removal of small diameter trees could occur in IRAs to meet T&E species needs, or to restore conditions that would occur under natural disturbance regimes, provided it can be done without building roads. With alternative C, where all IRAs are in recommended wilderness, removal of small diameter trees would not be suitable. However, in the past, removal of small diameter material in IRAs has not often occurred due to poor economics of removing small trees on steep terrain in areas that are difficult to access (see figures 1-07 to 10 for timber suitability by alternative).

Because alternative C has more MA1b (recommended wilderness), this alternative is expected to have lower levels of fire suppression and more wildfire acreage than the other alternatives. Because many wildfires on the Forest in recent decades have been stand replacing and large (e.g. 10,000-50,000 contiguous acres), this could result in large areas that are in an early successional stage providing grass/forb/shrub habitats and more acres with snags and down woody material than with Alternatives A, B or D. This would be beneficial for species that are associated with early successional stages, snags, and down woody material, but would be detrimental to species that are associated with late successional stages or areas of dense cover (also see individual species discussions below). Wildfires also change the average patch size and the pattern of coniferous forest cover on the landscape. Compared to timber harvest, early seral patches created by wildfire are much larger, have less edge, and create greater reductions in mature forest connectivity (see forest pattern section in the vegetation section of DEIS Chapter 3 and the coniferous forest connectivity section below for more details).

Alternative D has the highest number of acres in MA 6c and reflects a more intensive timber management strategy across the landscape to achieve desired vegetation conditions. Strategies may include more regeneration harvest or more treatment acres within a short time period in certain priority areas, such as the wildland-urban interface. The Salish Mountains GA, for example, has the highest acreage of NFS lands in wildland-urban interface areas west of the city of Kalispell and other communities (about 131,000 acres). Prescribed fire is used to achieve desired conditions in areas where timber harvest is not feasible.

With all alternatives, timber harvest, prescribed burning, precommercial thinning, and planting of ponderosa pine (if needed) would occur in the warm-dry and portions of the warm-moist biophysical settings (that are dominant within the wildland-urban interface on all lands) to restore/maintain stand composition and density to nearer historic conditions. These treatments would make forests more sustainable and resilient to large-scale disturbance, but may not restore snag levels to historic conditions. Vegetation treatments would reduce stand densities, especially in the mid-story canopy layer, and increase the likelihood that large and very large trees would be able to survive drought, insect attacks, and/or wildfire. Treatments would benefit some wildlife species associated with a small patch mosaic (see individual species discussions below), but may not benefit others. Planting of timber harvest areas is conducted in conformance with regulation and policy governing stocking levels.

Cumulative Consequences to Most Species Associated with Coniferous Forest Habitats

This section summarizes activities and effects that are common to most species associated with coniferous forest habitats. Also see the individual “Cumulative Effects” sections for each species discussed in the wildlife analysis of this DEIS.

In the past, coniferous forest lands in the Flathead valley bottom were cleared to create agricultural lands. This resulted in loss of habitat for species associated with the dry ponderosa pine forests that formerly occupied much of the valley-bottom and created habitat for species that forage in grasslands or hay fields. In the past few decades, agricultural lands have been subdivided for residences as the human population has grown. In the future, increased urbanization and population growth of the Flathead Valley is expected to lead to increases in forest land clearing and conversion of habitat; increased loss of open space and loss of connectivity due to subdivision of agricultural lands; increases in non-native and invasive species; and greater need for structure protection with less fire-fighting resources available for other suppression activities. Subdivision of private property also has the potential to increase disturbance, causing displacement of those species that are sensitive to human disturbance. For some species, private land development may cause them to shift habitat use to undeveloped lands in Glacier National Park, the Forest, other private timberlands, or other state lands managed by Montana Fish, Wildlife and Parks or the Department of Natural Resources and Conservation. As a result of a growing human population, higher levels of recreation use (both motorized and non-motorized) in areas that previously had low levels of use could increase impacts to species that are sensitive to disturbance during certain times of the year (see individual species sections for more details).

Timber harvest, fire suppression, thinning, planting, and wildfires are the past activities that have had the greatest influence on the amount and distribution of forested habitat on NFS lands, as well as state and private timber lands. These activities have created a variety of successional stages, structures, tree species mixes, and forest patterns which have supported many, but not all wildlife species.

In the past, decades of very active fire suppression led to build up of fuels at the same time when more people were moving into areas adjacent to and intermingled with the Flathead national forest. Fire suppression in the warm-dry and portions of the warm-moist biophysical settings in particular has changed stand structure and led to increased tree densities in forest that were historically more open stands. In the future, fuels reduction efforts are possible on all land ownerships, in particular in the wildland-urban interface where they are private residences.

In the future, timber harvest (including salvage of fire or insect-killed trees) occurring on private, state, or NFS lands may cumulatively affect the quantity and quality of wildlife habitat, especially in the valley bottoms where people live. The effects to wildlife are difficult to predict because they would depend on a wide variety of factors (e.g. whether habitat that is outside of historic conditions is restored, the type and location of harvest units). If this is done in such a way that it restores wildlife habitat that has been degraded by fire suppression, then habitat can be improved. If not, then habitat quality and quantity may be reduced (see Vegetation section of chapter 3 for more details). The desired conditions for vegetation in the revised forest plan would maintain or improve diversity of forested habitats on the Forest. Other forest land managers (e.g the Department of Natural Resources and Conservation) also have land management plans (e.g. Habitat Conservation Plan) to address wildlife needs and employ wildlife biologists to address desired conditions for wildlife on their lands.

In the past, many miles of road were built to access federal, state, and private lands. Forest roads and human developments have resulted in direct loss of habitat for some wildlife species. For example, roads have made adjacent areas more accessible to removal of snags for firewood gathering and the impact is greatest near coummunities (see sections on snags and individual species sections below for more discussion on the effects of roads)Forest roads have also increased human disturbance, which some wildlife species are sensitive to (see individual species sections).

Many miles of forest roads on all land ownerships have now been closed with gates, berms, or have been rehabilitated or decommissioned in the last few decades. This has reduced access for hunting and trapping of wildlife species. As on NFS lands, disturbance associated with open roads, administrative use of closed roads, and non-motorized human presence will likely continue. Administrative use of roads closed to the public increases during emergency response situations, such as wildfire response, and also during timber harvest preparation and implementation. Animals continue to be killed by vehicle collisions on highways in the valleys.

In the past, non-native species invasion of Forest lands has occurred due to a variety of activities including road building, timber harvest, grazing, livestock use of trails, and recreational activities, Multiple agencies, counties, and private organizations are involved in educating the public on the importance of preventing spread on non-native species and many agencies engage in management actions to prevent or control infestations. Grazing has occurred and will continue to take place on private lands, which may cause effects such as cowbird nest parasitism on Forest lands that are close to private lands that house livestock.

In summary, the cumulative effects of proposed management direction on the Forest, in the context of all lands of the larger landscape, contribute to the ecological integrity of coniferous forest habitats. This would be accomplished by plan components to protect soils and provide highly diverse vegetation composition, structure, and function. While the USFS cannot control all stressors in coniferous forests, restoration activities would support habitats that have been affected by past management and promote forests that are ecologically sustainable, while providing for social and economic sustainability.

In addition to effects on most species associated with coniferous forest habitats, the following sections describe species-specific effects. For coniferous forest connectivity, see the section following marten.

Flammulated Owl (SCC)

Key indicators for analysis

Most of the needs of flammulated owls are addressed by coarse-filter plan components for vegetation. In addition to the plan components, indicators, and effects described for “coniferous forest habitats in a variety of successional stages” and “Old Growth Habitat, Very Large Live and Dead Trees >20” dbh”, the following indicators apply:

- Plan components to support key ecosystem characteristics for the flammulated owl

Affected environment

Flammulated owl population, life history, habitat and distribution: The flammulated owl is designated as a species of conservation concern by the regional forester (see www.fs.usda.gov/goto/flathead/SCC). The flammulated owl is a small neo-tropical migratory bird known to breed in scattered areas of British Columbia the western states, including western Montana, and winters in Mexico. This long-distance migration habit and low natal site fidelity are believed to contribute to genetic interchange between populations in different mountain ranges (COSEWIC 2010). Flammulated Owls are usually found in distinct aggregations of up to 10 territories (Arsenault et al. 2002 *IN* COSEWIC 2010). Flammulated Owl males had mean home ranges of about 35 acres in Colorado (Linkhart 1984) and about 40 acres in Oregon (Goggans 1986). The population status and trend of flammulated owls in Montana is unknown.

The Avian Science Center conducted surveys throughout a large portion of suitable breeding habitat in 2005 (Cilimburg 2006, Smucker and Cilimburg 2008). They located flammulated owls on all but three of the National Forests in Region 1; no owls were detected on the Lewis & Clark, Custer, or Gallatin National Forests. The survey detected 243 Flammulated Owls on 78 transects across the Region, with the highest occupancy rates on the Nez Perce, followed by the Lolo, Bitterroot, and Helena NFs. The lowest occupancy rates occurred on the Idaho Panhandle, Clearwater, and Flathead Forests. Flammulated owls have been detected in 2 geographic areas of the Forest; the Swan Valley and Salish Mountains GAs. There are also very few historic records of Flammulated owls on the Forest, likely due to detection difficulty and naturally low amounts of key habitats.

McCallum (1994) and Hayward and Verner (1994) reviewed flammulated owl habitat, behavior, and general ecology. The structure of mature ponderosa pine/Douglas-fir forest is a key ecosystem characteristic for flammulated owls. Forest structure that includes a mosaic of: 1) mature forest with moderate canopy cover (35 to 65 percent), 2) large snags for nesting, 3) open, grassy patches for feeding and 4) dense thickets of small trees and shrubs in the understory for roosting, is key ((Reynolds and Linkhart 1992 *IN* Wisdom et al. 2000)(COSEWIC 2010). On the Flathead National Forest the warm-dry and portion of the warm-moist biophysical setting with ponderosa pine/Douglas-fir is capable of having these characteristics (figures B-10).

This cavity-nesting bird primarily nests in ponderosa pine snags (COSEWIC 2010), in cavities excavated by pileated woodpeckers (Aubry and Raley, 2002) northern flickers, or sapsuckers (Cilimburg 2006), but they may also nest in large live trees with heartrot. In their study of the breeding status of flammulated owls in Montana, Seidensticker and others (2013) found that ponderosa pine comprised 72% of all cavity-bearing trees used by flammulated owls; Douglas-fir comprised 26% and westerm larch. Ninety-three percent were dead trees. Cavity-bearing trees were most often broken-top trees in the 20-50 foot height class. Forty-five percent were in the 14-22 inch dbh class, with a median dbh of 21 inches and a range of 10-46 inches dbh.

Flammulated owls prey primarily on nocturnal moths and insects, which have a higher abundance and are more easily caught in open forest stands or in grassy openings. Prey availability appears to be the primary factor for migration patterns, but winter habitat requirements are poorly known.

Samson (2006a) estimated the amount and distribution of flammulated owl habitat in USFS Region 1 and for each of the Northern Region National Forests. Samson (2006b) also developed habitat estimates for maintaining viable populations of flammulated owl in Region One. Bush and Lundberg (2008) provided an update of habitat estimates for the Region One Conservation Assessment. These analyses indicated that the type of habitat used by flammulated owls during the breeding season is abundant and well distributed across Region 1 national forests as a whole. Compared to other national forests in Region 1 such as the Bitteroot, NezPerce-Clearwater, and Idaho Panhandle, the Forest has a low acreage of flammulated owl habitat as well as low potential to provide flammulated owl habitat, due to the relatively low potential to grow ponderosa pine.

The natural range of variation for the ponderosa pine dominance type on the Forest is 0.5-3% of the forest acres and current levels are 0.4%. There has been a downward trend in the ponderosa pine dominance type on the Forest, mirroring that documented in the Interior Columbia Basin Ecosystem Management Project assessment for the Northern Rocky Mountain Province, which noted significant decreases in shade-intolerant dominance types (including ponderosa pine) across that ecosystem (Hessburg et al. 1999b, 2000a; USDAFS 1996, Assessment of the Forest April 2014). Nearly 90% of this type occurs in the Swan Valley GA. The remainder occurs in the south end of the Salish Mountains GA and in the South Fork Flathead River GA, including the Bob Marshall Wilderness. Analysis on the Forest has also identified that trees in both the large and very large size class within the warm-dry and warm-moist biophysical settings where flammulated owls nest is below NRV (see the snag discussion in the "Forest Vegetation" section of the DEIS for more details).

Key stressors under Forest Service control

Land management: Fire suppression in ponderosa pine/Douglas-fir forests has created a dense forest structure that does not provide the structural characteristics needed by flammulated owls. Timber harvest that removes large nesting trees and road access that makes nesting areas accessible to firewood gathering reduce nesting sites. Wildfire or prescribed fire that creates a habitat mosaic is beneficial, but stand-replacing wildfires can reduce the mosaic of habitats needed for nesting, feeding and roosting.

Key stressors not under Forest Service control

Land management and development: Fire suppression, some types of timber harvest, road access that makes nest trees accessible to firewood gathering, and stand-replacing wildfires in the warm-dry and ponderosa pine/Douglas-fir portion of the warm moist biophysical settings on non-NFS lands can change the stand structure needed for nesting, feeding and roosting. This owl is also susceptible to threats associated with migration and while in it's neo-tropical wintering habitat.

Summary of alternative consequences

With all alternatives, key ecosystem characteristics described in the affected environment would be supported by implementation of coarse filter plan components. The desired mix of vegetation management activities to achieve desired conditions in ponderosa pine/Douglas-fir forests varies by alternative, as described below, but all alternatives have plan components to support key ecosystem characteristics for the flammulated owl. All alternatives include standards for retention of existing old growth and retention of large or very large live trees and snags in harvest units, where available. These standards would help to provide nesting sites for flammulated owls. The action alternatives have desired conditons for forest composition, structure, desnity, pattern, and function which would benefit flammulated owls.

In order to assess key aspects of flammulated owl habitat, effects of alternatives on NRV, current conditions, and effects of alternatives were modeled by Ecosystem Research Group (Appendix 3). The natural range of variation (NRV) was modelled going back about 1000 years and effects of alternatives were projected for the next 50 years, including anticipated changes in climate and the fire suppression logic of the model. Modelled habitat included forests with ponderosa pine and Douglas-fir with an average diameter greater than 15-inch d.b.h. and average canopy cover of 15- 40%. Based upon FIA data, forests with an average diameter greater than 15-inches DBH contain sufficient snags to provide habitat for the species that excavate nesting cavities used by flammulated owls (pileated woodpeckers and flickers). The logic pathways of the SIMPPLLE model show that dense stands of potential habitat (stands >40% canopy closure) will convert to highly suitable habitat (stands <40% crown closure) if treated by underburning, are burned by low-to-moderate severity wildfire, are attacked by Douglas-fir beetles, or are harvested or commercially thinned to remove understory and midstory trees.

The model predicts all alternatives but C maintain habitat between minimum and maximum NRV levels for the 5 decade time period. Alternative C exceeds the maximum NRV by the end of decade 5. The natural range of variation (NRV) of modelled habitat for flammulated owls ranged from about 12,000-37,000 acres out of approximately 2.4 million acres on the Forest, a very small amount and a very small range about 25,000 acres. In the future, acres of habitat increases from current levels during all 5 decades for all four alternatives. For alternatives B and D, acres of current habitat are slightly higher than the minimum NRV and increase to levels approximating the maximum NRV by the end of decade 5.

The reasons for modelled results may be attributable as much to vegetation treatments as natural disturbances. The emphasis on methods used to achieve desired conditions and the rate of their implementation would differ (e.g. timber harvest and/or prescribed fire), according to the mix of MAs for each alternative. In the warm-dry biophysical setting of the Flathead National Forest, vegetation modelling shows that over the next 50 years, all alternatives show a strong upward trend in ponderosa pine presence and dominance type associated with a strong decrease in Douglas-fir and in stand densities. These changes achieve the desired conditions for this setting and are favorable for the flammulated owl. In the Warm Moist biophysical setting, the forest size classes show desirable trends in all alternatives. The very large tree component is maintained at current levels, which is within the desired range. The moderate and high forest density class is currently a very high proportion of the warm moist setting, and it declines somewhat over the five decades. This is a desirable trend to increase overall resilience of the forest at the landscape scale and would benefit the flammulated owl (see Fire and Vegetation sections of the Forest Plan Assessment and this DEIS for more details). Because most flammulated owl habitat is at low elevations and in the wildland-urban interface (WUI), wildfires would be actively suppressed under all alternatives in most cases. Because flammulated owls prefer more open forests, it would be necessary to use timber harvest and prescribed burning as tools to achieve desired conditions. In the WUI, the most likely source of future snags would be those created by insects and disease or prescribed fire.

Alternative A was modeled without prescribed burning, which likely explains why it consistently produces less flammulated owl habitat through all time steps. Alternative B produces the most flammulated owl habitat, likely as a result of modelled vegetation treatments that include timber harvest, precommercial thinning, and prescribed fire. Alternative C would achieve desired conditions at a slower rate and a greater emphasis on use of prescribed fire, due to more acres designated as MA 6a or MA6b, compared to the other alternatives. Alternative D produces slightly less habitat than B, likely due to more regeneration harvest and more acres designated as MA 6c, general forest high intensity. These effects would also be dependent upon budget (see timber harvest and vegetation sections of Chapter 3 for more detail).

With all alternatives, USFS policy and regulations regarding firewood gathering on NFS lands would apply. These regulations restrict firewood gathering to within 200 feet of open roads, thus limiting the magnitude and extent of snag loss across the Forest. Road access restrictions for the grizzly bear would also help to retain snags used by flammulated owls for nesting (see grizzly bear section for more details).

Environmental consequences alternative A

The 1986 Forest plan does not have management direction specific to flammulated owls, but direction for management of old growth, snags, and down wood benefits flammulated owls.

Environmental consequences alternatives B, C, and D

Plan components included in the action alternatives would protect existing old growth ponderosa pine forests that provide flammulated owl habitat and would promote development of future old growth ponderosa pine forests. Plan components would provide for retention of large snags and trees with heartrot which are a key ecosystem characteristic to support flammulated owl nesting. In addition, species-specific desired condition FW-WL-SCC-01 expresses the desired condition that ponderosa pine forests in the warm-dry and warm-moist biophysical setting include:

- old growth and mature forest with presence of large/ very large snags,
- a patchy structure, including areas with an open mid-story and patches of dense Douglas-fir seedlings/saplings for roosting in the understory,
- small openings for feeding (also see appendix C).

All action alternatives would provide key ecosystem characteristics by moving habitat conditions towards the historic structure of ponderosa pine forests by creating a variety of successional stages that are used by flammulated owls for feeding and roosting in the warm-dry and ponderosa pine portion of the warm-moist biophysical settings. By moving towards the desired conditions for vegetation, the amount and distribution of flammulated owl habitat will approximate what would have been present under natural disturbance processes over the long-term, although it may take many decades for the effects of this to occur. Treatments would make ponderosa pine forests more resilient to drought and stand-replacing wildfires. If very large ponderosa pine trees are killed by mountain pine beetles or very large Douglas-fir trees are retained and later killed by bark beetles or root rot, this would provide nesting habitat for flammulated owls.

Cumulative consequences

Within mature ponderosa pine forests of the Bob Marshall wilderness, snags and decayed live trees used for nesting are not accessible for firewood gathering and are abundant due to recent wildfires. On managed lands of the Swan Valley and Salish Mountains GAs, past timber harvest and firewood gathering in areas providing nesting habitat, and conversion of ponderosa pine forests to agriculture or home sites on private lands, make it likely that flammulated owl numbers decreased on all lands as their habitat decreased. In the last few decades, timber harvest levels on federal lands have decreased. NFS lands in the Swan Valley still have very large, legacy ponderosa pine trees.

Habitat for the flammulated owl also declined from the 1940's to 1980's due in part to fire suppression (Casey 2000). Fire suppression allowed young Douglas-fir trees to suppress the recruitment of shade intolerant ponderosa pine, increased stand densities, as well as reducing the amount of open understory needed by this owl for foraging. Those stands that contain larger ponderosa pine may also be at a higher risk of stand replacing disturbance (wildfire/insects) due to their high density and abundance of ladder fuels. Reduction of stand densities on all lands would make these stands more resilient to wildfire and drought. Much of the ponderosa pine on the Flathead Forest is in the wildland-urban interface with areas of intermingled private ownership, so the use of fire for restoration may be limited in the future. However, timber harvest and prescribed fire can be used as tools to reduce fuels and create the mosaic of conditions needed by flammulated owls. Adjacent national and state forest land managers have instituted programs to retain old growth and to restore structure and composition ponderosa pine forests on suitable lands.

The preliminary Northern Region Adaptation Partnership risk assessment for the flammulated owl (NRAP 2015) stated that range-wide, the expected effects of climate change are not straightforward, with an unknown magnitude and likelihood. Disturbances such as stand replacing wildfire could reduce current mature dry forests, turning large acreages into primarily young forests or to grasslands or shrublands or these changes could be offset by increased habitat qualities in what are currently more mesic forest types (NRAP 2015). If the climate becomes warmer, it will favor the vegetation conditions that flammulated owls prefer (open, ponderosa pine or dry forest habitats). Changes in the timing of prey availability may also affect flammulated owls (Jones and Cresswell 2010), but is uncertain.

In summary, the cumulative effects of the proposed forest plan alternatives, in the context of all lands of the larger landscape, would contribute to the ecological integrity of ponderosa pine/Douglas-fir habitats that support the flammulated owl. This would be accomplished by plan components to increase the resilience and reduce the density of ponderosa pine stands with mature and old trees, retain snags and decayed trees (used for nesting), and to promote an understory mosaic consisting of patches of dense saplings and grassy openings (used for feeding and roosting). Within mature ponderosa pine forests of the Bob Marshall wilderness, snags and decayed live trees used for nesting are not accessible for firewood gathering and are abundant due to recent wildfires. In addition, plan components to limit road access help to protect snags and decayed live trees. The abundance and distribution of ponderosa pine on the Forest is naturally limited by topography and habitat type, thus limiting the Forest's ecological capacity to provide nesting habitat. While the Forest does not have authority over all stressors that may affect the flammulated owl (such as loss of snags or suitable forest structure on private lands), the Forest contributes to the Forest contributes to the ecological conditions that support them.

Clark's nutcracker (SCC)

Key indicators for analysis

- Management direction to support key ecosystem characteristics including live, seed-producing whitebark pine and ponderosa pine

Affected environment

Population, life history, habitat, and distribution: This species has been designated as a species of conservation concern for the Forest by the regional forester (see www.fs.usda.gov/goto/flathead/SCC). The Clark's nutcracker is distributed across the western U.S. and southwestern Canada. While not at risk across its range, there is concern for population decline in some areas due to a decline of its primary nesting season habitat as a result of an introduced disease (see Vegetation section of Chapter 3 for more details).

Clark's nutcrackers occur in northwest Montana year-round. Key ecosystem characteristics include high elevation conifer forests found in the cold biophysical setting (figures B-10) with presences of live, seed-producing whitebark pine to provide sufficient food to support nesting. This species is associated with live, seed-producing ponderosa pine found in the warm-dry and warm-moist biophysical settings (figures B-10, and B-11 to 16) at lower elevations to provide food during winter. Although the occurrence of ponderosa pine is very limited on the Forest, nutcrackers have readily adapted to food sources associated with people in winter and are attracted to bird feeders, picnic grounds, and human habitations.

Loss of mature whitebark, limber, and ponderosa pines to disease, insect outbreaks, and fire may lead to local and widespread nutcracker population declines (Tomback 1998). Clark's nutcrackers appear to be in decline in portions of northwest Montana. Sightings of this species have declined in Glacier National Park as well as on the Forest. Teresa Lorenz, research wildlife biologist with the Pacific Northwest Research Station, visited the area in 2009 with the intent of beginning a study, but could not locate enough birds. Breeding bird surveys, used to monitor populations of Clark's nutcrackers in Montana, indicate a non-significant decline in numbers of Clark's nutcrackers of 2.2% per year in Montana from 1980-2007, coincident with declines in whitebark pine due to blister rust infection in northwest Montana. Obtaining statistically significant trends for this species is difficult. According to Lorenz (2008), BBS data are particularly limited in value for monitoring species like Clark's nutcrackers that are not actively nesting when the counts are actually being conducted, that are non-territorial and wide-ranging.

The Clark's nutcracker is a specialist on large conifer seeds. (Lanner 1996, Tomback and Linhart 1990). Adult nutcrackers are heavily dependent on seeds from live whitebark and limber pine during the breeding season (Tomback and Linhart 1990), especially during the summer post-fledging period (Vander Wall and Hutchins 1983). Unlike the east side of the continental divide, the Flathead National Forest does not have limber pine. As summarized by Lorenz (2008) "On a landscape scale, conifers do not produce the same amounts of seed every year. Years of heavy seed production are often followed by 1 to 3 years of low or moderate production. Nutcrackers therefore must be highly opportunistic and adaptable in order to survive years of low seed production. Many aspects of the nutcracker's life history, such as their varied diet and their yearly movements, reflect this opportunistic nature. Other aspects, including morphology and the timing of the breeding season, reflect their dependence on conifer seed".

The effects of long-term whitebark pine seed declines on Clark's nutcrackers are unknown. Although they are known to feed on Douglas-fir seeds, this is a low energy seed that may not be sufficient to support breeding (D. Tomback, U. of Colorado, pers. comm. with Cara Staab, 2015).Observations of nesting nutcrackers across years suggest that adults attempt to breed only in years that they have sufficiently large stores of seeds (Tomback 1998). Nutcracker young typically fledge in April and May. Shortly after the young fledge, snow begins melting in subalpine areas, especially on the south-facing slopes, where adults have placed caches the previous fall. Adult nutcrackers may also harvest unripe seeds from whitebark pine cones as early as July (Tomback 1978, Vander Wall and Hutchins 1983), but seed harvesting rates increase once cones ripen. The Clark's nutcracker is the primary disperser of the large whitebark pine seeds, helping to perpetuate its primary food source. Because the Clark's nutcracker has a mutualistic relationship with whitebark pine trees, the decline in whitebark pine puts both Clark's nutcrackers and whitebark pine trees at risk in localized areas due to human-caused disruption of seed-dispersal mechanisms (McKinney et al. 2009).

If large-scale mortality of whitebark pines is leading to an increase in the number of nonbreeding years for Clark's nutcrackers, there could be serious population-level and ecosystem consequences (Schamin 2015). Schaming (2015) studied Clark's nutcrackers in the Greater Yellowstone Ecosystem and found there was population-wide failure to breed during years of low white-bark pine cone production. If birds did not have sufficient stores of cached seeds in the fall, they did not breed the following year. She also measured body condition index during the breeding season and found that it was significantly lower in non-breeding years. The habitat carrying capacity for this species is diminished due to the loss of a key breeding season food source and the lack of a high calorie back-up seed source west of the continental divide (D. Tomback, Professor and Associate Chair, Department of Integrative Biology, University of Colorado Denver; pers. comm. 2016).

On the Forest, there are only two conifer species which produce large seeds (whitebark pine and ponderosa pine), and occurrence of both of these tree species is low (see Vegetation section of Chapter 3 for more details). Whitebark pine was designated by the US Fish and Wildlife Service as a candidate species for listing under the Endangered Species Act in July of 2011. Three whitebark pine ecosystems have been identified in Montana; the Northern Divide, The Greater Yellowstone, and the Bitteroot ecosystem.

McKinney and others estimated that forests must have a basal area of at least 21.8 sq. ft./ac. for a high likelihood of seed dispersal by nutcrackers (McKinney et. al. 2009). Nutcracker occurrence, seed dispersal, and whitebark pine regeneration are lowest in northern Montana (Keane and Parsons 2010). According to FIA data (USFS 2015), the Forest is well below this threshold (table 32).

Table 31. Basal area of whitebark pine on the Forest

Live Whitebark Pine Trees	Basal Area for the cold biophysical setting	Basal Area for the cool moist-moderately dry biophysical setting
>=10" dbh ("mature", may be producing cones)	6.1 sq. ft./ac.	1.5 sq. ft./ac.
>=15" dbh ("mature", more likely to be producing cones)	1.1 sq. ft./ac.	0.4 sq. ft./ac.

The Forest is in the Northern Divide ecosystem, where forests have been suffering from introduced blister rust infection for a longer period of time than forests in other regions (Fiedler and McKinney 2014). On the Forest, many mature trees have been dead for 30 years or more, so there are many acres that no longer provide a summer seed source for Clark's nutcrackers. Mortality from blister rust reaches 90 percent or higher in some whitebark pine forests in the Northern Rocky Mountains (McKinney at al. 2009). In addition to blister rust, this region has seen mortality in whitebark pine from outbreaks of mountain pine beetles. Whitebark pine is also experiencing successional replacement by shade-tolerant species in some areas where fire has been absent (Tomback 2007). The coevolved, mutualistic whitebark pine-nutcracker interaction facilitates rapid regeneration of whitebark pine after fire, but if nutcrackers are not present because seed densities are too low, the tree is not likely to regenerate, even with favorable environmental conditions. Once trees regenerate (either naturally or by planting), they are not expected to produce seed for Clark's nutcrackers to feed upon for many decades (see section 3.5.1).

The natural range of variation for the whitebark pine dominance type on the Forest is 2-7% of the forest acres and current levels are 2.4%. The natural range of variation for the ponderosa pine dominance type on the Forest is 0.5-3% of the forest acres and current levels are 0.4%. There has been a downward trend in the ponderosa pine dominance type on the Forest, mirroring that documented in the Interior Columbia Basin Ecosystem Management Project assessment for the Northern Rocky Mountain Province, which noted significant decreases in shade-intolerant dominance types (including ponderosa pine) across that ecosystem (Hessburg et al. 1999b, 2000a; USDAFS 1996, Assessment of the Forest April 2014).

Key stressors under USFS control

Land Management: USFS management actions can affect maintenance and restoration of live, seed-producing whitebark pine and ponderosa pine.

Key stressors NOT under USFS control

Climate change: Climate change has the potential to impact whitebark pine ecosystems (Bartlein and others 1997) and so too Clark's nutcrackers.

Summary of alternative consequences

Whitebark pine trees are a key ecosystem characteristic for the Clark's nutcracker during the nesting season. All action alternatives include plan components to restore the ecological integrity of whitebark pine communities. To contribute to range-wide restoration efforts, the design, planning and implementation of whitebark pine treatments on the Forest would be guided by the principles within a whitebark pine restoration strategy developed by Keane and others (2012) under all alternatives. To the degree possible at the forest-wide scale, restoration efforts would be directed towards promoting whitebark pine rust resistance, conserving genetic diversity, saving seed sources, and implementing restoration treatments. Restoration of whitebark pine is a long-term undertaking. Plan components of the action alternatives would support key ecosystem characteristics for the Clark's nutcracker, by providing for whitebark pine restoration. Plan components would allow for reduction of competing trees and ladder fuels around existing disease-resistant survivors, allow for collection of seeds to grow nursery stock, and allow for planting (see sections 3.3.4 and 3.5.1 for more details on whitebark pine and ponderosa pine). There are no species-specific plan components for the Clark's nutcracker because their needs are addressed by coarse filter plan components.

Modelling of future vegetation shows that none of the alternatives achieves the desired minimum level of whitebark pine presence within the next 5 decades, though within the cold biophysical setting there is a slow upward trend. Due to the severe effect of blister rust and insufficient density of cone-producing trees to support Clark's nutcrackers to disperse seed, an aggressive restoration program, including planting of rust-resistant seedlings, would likely be needed to accelerate the rate of recovery for whitebark pine and increase live, seed-producing whitebark pine as well as nutcrackers over time. Treatments would increase the likelihood that blister-rust resistant whitebark pine of all sizes would have an increased chance of surviving in likely future environments that may include drought, wildfire, disease, and insects, benefitting Clark's nutcrackers.

Environmental consequences alternative A

The 1986 Forest plan did not have management direction for Clark's nutcrackers, nor for restoring the whitebark pine forests they nest in, nor their ponderosa pine winter habitat. Nevertheless, efforts have been made to cage cones to collect Whitebark pine seeds to grow nursery stock. Cooperative projects to plant whitebark pine in recently burned areas have also occurred.

Environmental consequences alternatives B, C, and D

All alternatives include desired condition FW-WL-SCC-01 which states that habitat conditions and ecological processes that support wildlife species of conservation concern contribute to populations that persist over the long term, with sufficient distribution to be resilient and adaptable to stressors and likely future environments. Plan components FW-DC-PLANT-02, FW-GDL-PLANT-01 and FW-OBJ-PLANT-01 would promote restoration of mature, seed-producing whitebark pine. FW-DC-TE&V-07 and 08; FW-GDL-TE&V-01 and FW-OBJ-TE&V-01 would promote restoration of ponderosa pine (also see appendix C). These coarse filter plan components would support key ecosystem characteristics for the Clark's nutcracker on NFS lands.

Cumulative consequences

Ponderosa pine in the northern region is expected to handle increasing temperatures and deeper, longer droughts with only moderate difficulty. Wildfires create a suitable environment for natural regeneration of whitebark pine, but this would only occur naturally if there are enough nutcrackers and enough seeds for them to cache. If fires are too frequent, established regeneration will never grow above the lethal scorch height, and mature individuals will not become established, affecting nesting season food available for Clark's nutcrackers. Increasing fire severity and occurrence could also eliminate many live, mature ponderosa pine (NRAP 2015, Chapter 6).

Whitebark pine occurs at high elevations in Glacier National Park and Salish/Kootenai tribal wilderness areas, adjacent to the Forest, where it is also in decline. After enough consecutive years with low seed production, Clark's nutcrackers may not continue to reproduce on the west side of the continental divide, but may continue to reproduce east of the continental divide where there are live, seed-producing limber pine, another breeding season food source.

Many land managers on the west side of the continental divide, as well as several private organizations, have an interest in maintaining and increasing the live whitebark pine trees that support breeding populations of Clark's nutcrackers (see Vegetation section for more details). On all lands, there is a risk that the few remaining patches of live, seed-producing whitebark pine may be killed—either by disease, insect infestation, or stand-replacing wildfire. This would make even less food available for Clark's nutcrackers for many decades, because whitebark pine grows in a harsh environment where it takes decades to reach seed-producing size. Planting or seeding of rust resistant whitebark pine on all lands would be beneficial. It is uncertain whether planting would be allowed in recommended wilderness (MA1b) in the future (if it becomes wilderness designated by Congress), because some people consider planting to be "trammeling", which is not allowed under the Wilderness Act.

In summary, the cumulative effects of the proposed forest plan alternatives, in the context of all lands of the larger landscape, would contribute to the ecological integrity of whitebark pine and ponderosa pine habitats that support the Clark's nutcracker. This would be accomplished by plan components to promote seed-producing ponderosa pine that provide a key winter food source and plan components to restore mature, seed-producing whitebark pine that provide a key breeding season food source. The abundance and distribution of ponderosa pine and whitebark pine on the Forest is naturally limited by factors such as topography and habitat type, thus limiting the Forest's ability to provide nesting and wintering habitat. While the Forest does not have authority over all stressors that may affect the Clark's nutcracker (such as a disease introduced off-forest), the Forest contributes to the ecological conditions that support them.

White-tailed deer

Key indicators for analysis

The public expressed an interest in this species during scoping. In addition to indicators for coniferous forest and wildlife associated with aquatic, wetland and riparian habitats, the following indicators are used for analysis of effects for white-tailed deer.

- Management direction to support key ecosystem characteristics providing snow intercept cover in key white-tailed deer winter habitats and reduce the risk of human disturbance in key winter habitat areas

Affected environment

Population, life history, habitat, and distribution: White-tailed deer are distributed across most of the U.S., southern Canada, and Central America. They are distributed across most of Montana and are the most abundant big game species on the Forest. They are of interest for hunting and observing. As of 1998, white-tailed deer populations in northwest Montana increased to an apparent record high level (compared to the previous 20 years). Mackie stated that this likely resulted from favorable habitat changes, mild winters, low hunter harvest rates, and possibly a numerical advantage favoring deer in the presence of predators (Mackie et al. 1998). Compared to other big game animals, white-tailed deer may be more sensitive to harsh winter conditions due to their small body size and short legs, with fawns being particularly susceptible to mortality during February and March (MFWP 2006). During or following particularly hard winters, mortality due to malnutrition occurs and snow accumulation may also make white-tailed deer more susceptible to being killed by a host of predators, especially mountain lions (MFWP 2006). If adult female harvest rates are high in conjunction with high predation and poor fawn recruitment, a significantly lower population could persist for a time even after a return to favorable environmental conditions (Mackie et al. 1998). White-tailed deer numbers have varied considerably since 1998 (a low point in recent decades), but MFWP reported that numbers are currently increasing (MFWP 2015 White-tailed Deer Management Report, T. Thier MFWP pers. comm. 2016).

There have been several studies of white-tailed deer in northwest Montana, including the Forest (Mundinger 1984, Morgan 1993, Morgan 2006, MFWP 2006).White-tailed deer are habitat generalists, associated with a wide variety of cover conditions and foods during most of the year. White-tailed deer are distributed across the Forest in summer. A study of white-tailed deer occupying northwest montane forests in the Salish GA of the Forest concluded that riparian areas and adjacent uplands containing pole/immature timber were very important as centers of deer use in summer (Morgan 1993). Mackie and others (1998) stated that timber management to optimize deer habitats in western Montana “should emphasize perpetuation or enhancement of habitat diversity”. Forest Service vegetation management activities have created diverse composition and structure, providing white-tailed deer habitat quantity and quality. Summer habitats are managed primarily by the USFS, whereas in winter habitat, NFS lands are often adjacent to or intermingled with private lands.

In winter, white-tailed deer are found in all the major river valleys of the Forest (see figure B-31). In the Salish Mountains GA, white-tailed deer winter primarily along the eastern fringe of lower foothills from Little Bitteroot Lake east to Ashley Creek, south to Smith Lake /Truman Creek and north to Pilot Knob (Mundinger and Riley 1982 *IN* Mackie et al. 1998) In the Stillwater River Valley whitetails winter from Lost Creek to the northernmost extent of Pete Ridge near Tally Lake (MFWP 2006). In the Swan Valley white-tailed deer winter from the area around Swan Lake south to the area near Holland Lake.

In winter, white-tailed deer primarily feed within forested areas, with Oregon grape, Douglas-fir and lodgepole pine seedlings/saplings, arboreal lichens, willows, and serviceberry shrubs making up a large portion of the winter diet. The conifer canopy also provides arboreal lichens that are blown to the ground or are available when tops of young trees are bent over by the snow (MFWP 2006). White-tailed deer are opportunistic in their habitat use during mild winters, but may rely on an energy conservation strategy during harsh winters.

Key stressors under USFS control

Land management: Human activities facilitated by open roads can have indirect effects on hunting harvest levels. Hunting season effects are discussed under the sections on grizzly bear and elk and also apply to whitetailed deer. Human activities can also affect deer during the winter months. Regeneration harvest can reduce snow intercept cover.

Key stressors not under USFS control

Hunting: All or portions of about 11 deer hunting districts occur on the Forest. Deer are hunted under a season that is regulated by MFWP.

Predation: In northwest Montana, the combined effects of multiple predators (e.g. mountain lions, wolves, bears) may exert greater and more consistent predation pressure on big game species compared to other environments with fewer effective deer predators (Mackie et al. 1998).

Climate change and weather: The temperature threshold between rain and snow causes estimates of snowpack to differ greatly between models (NRAP 2015; Chapter 9). In the valley-bottom habitats where white-tailed deer spend the winter, future winter climate is predicted to be warmer on average (with more precipitation falling as rain rather than snow), which would be beneficial to white-tailed deer and reduce their need for snow intercept cover. However, winter precipitation projections have a high level of uncertainty and extreme winters may still occur.

Private land development: Subdivision and commercial development of winter habitat can reduce habitat quantity and quality. White-tailed deer mortality is high in areas where they are concentrated along county, state, and federal highways or high-speed roads in the valley-bottoms, especially in winter when they are concentrated in these areas. Regeneration harvest can reduce snow intercept cover on state and private lands that provide snow intercept cover.

Summary of alternative consequences

Most of white-tailed deer winter habitat on the Forest (figure B-31) is in the warm-dry and warm-moist biophysical settings, where forest structure is most altered by fire suppression, timber harvest, and fuels reduction. Fire suppression targets much of the warm-dry and warm-moist biophysical settings because it overlaps the more heavily roaded, valley-bottom areas where people live, known as the wildland urban interface (wildland-urban interface). In some of these areas, fire suppression has resulted in a dense mid-story of Douglas-fir trees, creating a forest structure which provides snow interception for whitetailed deer, but which is not characteristic of historic conditions and which is not sustainable under expected future climate conditions (see section 3.3 for more details). Because most white-tailed deer winter habitat is in the wildland-urban interface, wildfires would be expected to continue to be suppressed under all alternatives. As a result, desired conditions for vegetation would primarily be accomplished by a combination of timber harvest, pre-commercial thinning, planting, and use of prescribed fire to provide a sustainable mosaic of forest conditions.

The differences in alternatives are due to different types of treatments and rates of treatment that would occur due to differences in management areas (MAs). In order to assess key ecosystem characteristics for white-tailed deer, effects of alternatives on snow intercept cover were modeled by Ecosystem Research Group (appendix 3). Ecosystem Research Group interpreted vegetation model outputs to estimate NRV, current, and potential future habitat including a warmer/drier climate over the next five decades, using the fire suppression logic associated with the model (appendix 3). The natural range of variation (NRV) was modelled going back about 1000 years. The model predicts all alternatives would stay within the minimum and maximum range of NRV over the 5 decade time period. The natural range of variation (NRV) for snow intercept cover in areas mapped as white-tailed deer winter range varied from about 29,518 to 110,721 acres out of approximately 325,491 acres of winter habitat on the Forest, a moderate range of variation of about 81,203 acres. The current level of habitat is estimated to be at the midpoint of NRV, at approximately 72,000 acres. With all alternatives, modelled habitat initially increases and then declines to a level about 20,000 acres below current by the end of the 5th decade. Changes are consistent with modelled increases in wildfire, insects and disease, which reduces canopy cover in some areas to the point that snow interception is no longer provided. Alternatives B and D provide slightly less snow intercept cover than A or C, likely due to vegetation treatments to meet other resource objectives in the warm-dry and warm-moist biophysical settings where the majority of the Forest's white-tailed deer winter habitat is located. With all alternatives, key ecosystem characteristics would support white-tailed deer during most winters, but the lack of snow interception provided by a canopy of full-crowned mature trees could cause higher levels of mortality, including indirectly due to predation, during harsh winters. All alternatives would limit human disturbance in white-tailed deer winter habitat because areas and trails suitable for motorized over-snow use (figures 1-24- to 26) are located to minimize harassment of wildlife or significant disruption of wildlife habitats.

Environmental consequences alternative A

The 1986 Forest Plan includes management area direction for White-tailed deer winter habitat (MA 9). Direction includes preparation of a long-range activity schedule for each winter range to provide the size, age, diversity, and distribution of habitat needed by this species; implementing habitat improvement projects; timber harvest to create small openings; with winter logging to provide winter food. Management specifies that at least 50 percent winter thermal and snow intercept cover is to be maintained in each winter habitat block. The 1986 Forest plan closes key big game winter habitat areas on NFS lands in MA9 to public motorized over-snow vehicle use (e.g. Pilot Knob and Pete Ridge in the Salish GA). Winter habitat management is coordinated with MFWP to support white-tailed deer populations that use Forest lands.

Environmental consequences alternatives B, C, and D

Key ecosystem characteristics described in the affected environment would be supported by plan components for vegetation structure, composition, and pattern included in all action alternatives.The action alternatives do not have management areas (MAs) specific to white-tailed deer winter habitat, but they have desired conditions for the warm-dry and warm-moist biophysical settings, which is where most winter habitat occurs. FW-DC-TE&V-09 provides key ecosystem characteristics for white-tailed deer and contributes to diverse and resilient forest conditions (see vegetation; fire and fuels sections of the Forest Plan Assessment and DEIS Chapter 3 for more details).

To achieve desired conditions, conifer trees in the understory and mid-story would be removed, while retaining large, full crowned trees in the over-story canopy to provide snow intercept cover. Achieving a lower stand density by removing mid-story and understory trees would make forests in key winter habitat areas better able to withstand drought or insect and disease outbreaks that would result in loss of snow intercept cover. However, removing understory Douglas-fir would reduce arboreal lichens and needles that provide forage in the understory canopy layers. As a result, desired conditions specify retention of clumps of conifer seedlings/saplings to provide forage during the winter and to grow into large trees as succession occurs. Achieving a lower stand density would also help to maintain shrubs in the understory and would increase wind in the canopy that blows arboreal lichens to the ground, making them accessible to deer for food. Guideline FW-GDL-TIMB-05 states that when harvesting timber in white-tailed deer winter habitat areas mapped by MFWP, sufficient live, full-crowned Douglas-fir and ponderosa pine trees should be retained in the uppermost canopy to provide snow interception to support deer survival during harsh winters (see appendix C for strategies, since this will vary over time on a site-specific basis). Plan components promote key ecosystem characteristics that support white-tailed deer habitat quality, quantity, and resilience.

There are also desired conditions for specific geographic areas (GAs) that address specific white-tailed deer winter habitats; GA-HH-DC-02, GA-NF-DC-11, GA -DC-05, GA-SV-DC-05 and guidelinesGA-SM-GDL- 02, GA-SV-GDL- 05, GA-HH-GDL- 02. With alternatives B and D, about 67% of the white-tailed deer winter habitat on NFS lands is in MA6b, MA6c, or MA4b management areas, where timber harvest would be likely to occur. With alternative C, about 50% is in these management areas.

Desired conditions for MA6 address motorized use. Plan components MA-6a-02 and 6b-DC-02 and 6c-02 state that there are opportunities for both motorized and non-motorized recreation, with some areas restricted by yearlong or seasonal closures to protect big game winter habitat, grizzly bear secure core, and/or wildlife habitat connectivity. In addition, road access standards for the grizzly bear would benefit white-tailed deer (see grizzly bear section for more details). All alternatives would maintain current areas where motorized use is not suitable in white-tailed deer winter habitats, with one exception. With the action alternatives, an area of less than 1,000 acres in lower Big Creek, out of a 27,000 acre area mapped as whitetailed deer winter habitat by MFWP in the North Fork Flathead River GA, would become suitable for motorized over-snow use (figures 1-24 to 26). This change in an area where motorized over-snow vehicle use would affect white-tailed deer habitat is a small percentage (about 4%) of the mapped winter habitat in one area.

Cumulative consequences

Residential subdivision of private lands is likely to continue or even increase in the future. Acquisition of former Plum Creek Timber Company lands, as well as conservation easements (that occurred in the Swan Valley under the Legacy Project with the USFS, MT DNRC, and private landowners) prevents residential subdivision that can result in loss of white-tailed deer habitat and promotes recovery of white-tailed deer snow intercept cover on lands that have had regeneration harvest. Conservation easements in other geographic areas (such as on the Stoltze property in Haskill Basin north of Whitefish) also helps to control residential subdivision.

In the past, severe winters, in combination with high populations of deer predators, have contributed to high mortality of white-tailed deer. MFWP manages both deer and predator populations through trapping and hunting regulations, adjusting regulations to meet population and harvest objectives. Deer harvest has been high, but the Forest continues to have very high populations of whitetailed deer. Glacier National Park, encompassing about a million acres adjacent to the Forest, is closed to hunting, but has high levels of deer predators.

Climate change may benefit white-tailed deer if more of the winter precipitation in the Flathead Valley falls as rain, but if widespread drought, stand-replacing wildfires, insect outbreaks or disease occur in winter habitats it could be detrimental. In general, whitetailed deer are habitat generalists that are very resilient. Vegetation management on all landownerships would benefit white-tailed deer if it is done in such a way that it maintains snow intercept cover for harsh winters, but increases habitat resilience. Whether this would occur or not is unknown, but many forest land managers have professional foresters, silviculturists, and wildlife biologists to coordinate timber management to benefit multiple resources.

In summary, the cumulative effects of proposed management actions on the Forest, in the context of all lands of the larger landscape, contribute to the ecological integrity of habitats that support whitetailed deer. This would be accomplished by plan components to maintain snow intercept cover for harsh winters and to promote a vegetation mosaic in large winter habitat areas. While the Forest does not have authority over all stressors that may affect whitetailed deer, the Forest contributes to the ecological conditons that support them.

Elk and mule deer

Key indicators for analysis

The public expressed an interest in these species during scoping. In addition to indicators for coniferous forest and wildlife associated with aquatic, wetland and riparian habitats, the following indicators are used for analysis of effects to elk.

- Management direction to support key ecosystem characteristics providing habitat diversity and habitat security during spring (calving) and fall (hunting) seasons.

Affected environment

Populations, life history, habitat, and distribution: Mule deer are distributed across all of western North America and all of Montana. Elk are distributed throughout the Rocky Mountains and have spotty distribution elsewhere in the western U.S. and Canada. They occur in most of western and central Montana. Elk and mule deer are less common on the Forest than white-tailed deer, but are of high interest for hunting and observing. The trend for elk populations on the Forest appears to be stable (T. Thier pers. comm. 2016). In 2004, MFWP reported that elk populations wintering in hunting districts that include the Forest were lower in number than in past decades, likely due to forest succession in the absence of wildfire. Acres of elk habitat burned by wildfire have increased since 2003 and many of the burned areas are now providing abundant forage. According to MFWP (2013) mule deer numbers in MFWP Region 1 appeared to hit a record low in 2011 after two severe winters in 2009–2010 and 2010–2011, but numbers were beginning to rebound in some areas in 2013 (Tim Thier MFWP pers. comm. 2013).

In mountainous regions such as the Forest, many of the mule deer and elk use distinct seasonal ranges, migrating locally through “transitional habitats” to lower elevations for all or a portion of the winter and moving to moist riparian habitats and higher elevations for the summer. Elk and mule deer habitat, mapped by MFWP, is discussed in more detail in the Forest Assessment (USDA FS 2014). Non-winter elk and mule deer habitat occurs across the whole Forest. Winter habitat overlaps with white-tailed deer winter habitat in some areas but also occurs in smaller areas associated with steep south and west facing slopes where wind and sun exposure reduce winter snow depths. Elk and mule deer are not as strongly associated with large areas of winter snow intercept cover at low elevations as white-tailed deer are. There have been several studies of elk habitat use on the Forest (Vore et al. 2007; Vore and Schmidt 2001; Biggins, D. E., 1975; Fuller, P. R., 1976; Simmons, C. A. 1974; Bureau 1992) and one study of mule deer habitat use on the adjacent Kootenai NF (Stansberry 1991). Stansberry (1991) found that steep south, southwest and west-facing slopes were used in greater proportion than their availability on the landscape during all seasons. Mule deer use all forest types, especially those with a fine-grained or small-patch mosaic. In winter, patches of conifer cover help to moderate temperature extremes, reduce wind velocity, and reduce radiant heat loss. Snow depth under the conifer canopy is also minimized, providing easier access to foraging sites during harsh winters (Youmans 1979).

Recent research has shown that the condition of elk going into winter is just as important as condition during winter. Elk and mule deer are known to forage on grasses, forbs, and shrubs in areas that are transitionally or permanently non-forested areas, interspersed with forested areas providing cover and security. Recent studies have also indicated that management can be improved by integrating nutritional ecology on elk summer range (Cook 2011). For example, many of the important food plants, including shrubs such as redstem ceanothus, serviceberry, and Rocky Mountain maple, as well as grasses, grow only in forest openings or in forests with a more open canopy. Proffitt and Hebblewhite (in prep.) suggest that a lack of disturbance due to long-term fire suppression were largely responsible for population declines in some areas. Spring and summer habitat use by mule deer on the Forest is similar to elk. In late fall and winter, mule deer may be found on small rocky cliffs interspersed with coniferous forests. Moist habitats are especially important to elk during calving. Research conducted during the 1970s on the Forest found that elk calving areas varied from year to year, depending upon snow depth.

Research indicates that elk prefer to have hiding cover near open habitats used for foraging (Thomas and Toweill 1982). On the Forest, very large stand-replacing fires have created large areas of forage where there may be a long distance to cover for the first 10-20 years after the fire. After several decades, trees may create enough shade that it substantially reduces forage. Controlled burns, timber harvest, pre-commercial thinning or other vegetation management strategies aimed at creating a mosaic of forest conditions can be beneficial to elk by providing abundant food resources in close proximity to cover and maintaining forage beneath the canopy of forested areas.

Elk winter habitat is mapped by MFWP. On the Flathead National Forest, there are two key elk wintering areas. One is in the Dry Parks, Horse Ridge, Spotted Bear River, and Spotted Bear Mountain winter range areas of the South Fork GA are monitored by MFWP on an annual basis. This area has areas of steep, open south or west-facing slopes interspersed with mature trees that provides winter habitat for approximately 300-400 elk, based upon MFWP annual survey reports. The Spotted Bear River portion of this elk habitat area was affected by high severity wildfires in 2015, resulting in extensive regeneration of winter habitat cover and forage. The Firefighter area in the Hungry Horse GA provides winter habitat for approximately 100 elk. These elk tend to use winter habitat with heavier cover of lodgepole pine forest (Vore et al. 2011). The number of elk and mule deer wintering on other portions of the Forest has not been studied, but they appear to be smaller groups of about 20-50. (J. Vore pers. comm. 2009, 2013).

Roads, forest cover, and topographic variation affect elk habitat connectivity. Elk response to roads was studied extensively in the 1980’s. Research has also shown that there is a direct relationship between level of road access and bull elk mortality (Leptich and Zager 1991, Unsworth and Kuck 1991). During hunting season, elk are known to select habitats with contiguous, nonlinear hiding cover patches over 250 acres in size and more than 0.5 mi from open roads (Hillis et al. 1991). These “security areas” help to maintain an elk population that is sufficient to provide hunter opportunity (Canfield et al, Chapter 6 in Joslin and Youmans 1999). Figure 1-31 displays elk security areas (also see grizzly bear section 3.7.5, since areas providing grizzly bear habitat security also provide elk security). Elk may make long distance seasonal movements. Tracking of elk with satellite transmitters has shown that they move from winter habitat on the CSKT Reservation to the west of Flathead Lake to spend the summer up to 60 miles north, near Fortine on the Kootenai National Forest (Stacy Courville 2012, unpublished report). In general, localized movements between seasonal habitats are not known to follow any particular travel corridor or linkage area (Stansberry 1991).

Human disturbance in areas where elk winter may cause stress. Research in Montana has found that cross-country skiers may be more disturbing to elk than motorized users (Canfield et al. IN Joslin and Youmans 1999). On the Forest there are two areas with groomed cross-country ski routes and they are not in areas mapped as winter elk habitat by MFWP. Key winter elk habitat areas in the South Fork Geographic Area are closed to motorized over-snow use in winter, also making them less accessible to cross-country skiers.

Key stressors under USFS control

Land Management: If not managed appropriately, vegetation and fire management can decrease habitat diversity for elk. Excessive open road density can decrease elk and mule deer habitat security.

Key stressors not under USFS control

Hunting: All or portions of about 11 elk and deer hunting districts occur on the Forest. Elk are hunted under a season that is regulated by MFWP.

Predation: Mountain lions (cougars), grizzly bears, wolves, black bears and coyotes can be effective predators of newborn elk calves through their first few months of life. Black bears have been documented as substantial predators of newborn elk calves in mountain environments (Schlegel 1976 IN Mackie et al. 1998).

Climate change and weather: Elk and mule deer have wide ranges and a high degree of plasticity towards habitat, which makes them resilient to a changing climate.

Summary of Alternative Consequences

Implementation of access management direction for grizzly bears would provide high levels of habitat security for elk at the forestwide scale (figure 1-24). Diverse forest structure and composition would be promoted by timber harvest, commercial and pre-commercial thinning, wildfire, insects and disease, and prescribed burning to meet desired conditions. Plan components for RHCAs or RMZs would support elk moist-site habitat. The mix of activities varies by alternative, as described below, but all would support key ecosystem characteristics for elk and mule deer.

In order to assess key aspects of habitat diversity for elk during the non-winter time period, effects of alternatives on NRV, current conditions, and effects of alternatives on elk non-winter forage were modeled by Ecosystem Research Group (Appendix 3). The natural range of variation (NRV) was modelled going back about 1000 years and effects of alternatives were projected for the next 50 years, including anticipated changes in climate and the fire suppression logic of the model.

The model predicts all alternatives would stay within the minimum and maximum range of NRV over the 5 decade time period, hovering somewhere around the midpoint of NRV and current levels. The NRV of foraging habitat for elk ranges from about 290,000 to 1,100,000 acres out of approximately 2.4 million acres on the Forest, a very large range of about 720,000 acres. With all alternatives, acres of habitat initially increases slightly and then declines back to current levels. In the future, there are very slight differences in alternatives. Alternative A is consistently outperformed by the other alternatives and this is most likely attributed to the lack of prescribed fire modelled for that alternative. With alternative D, desired conditions would primarily be achieved by timber harvest (which may be followed by prescribed burning). Alternatives B and C slightly outperform other alternatives, likely due to higher amounts of prescribed burning to meet multiple resource objectives.

Environmental Consequences Alternative A

Forestwide big game management direction includes incorporating moist site and security area recommendations displayed in Appendix DD. Moist sites for elk are a combination of forest habitat types and wetland or riparian features. Moist sites are site-specifically identified and analyzed at the project level. The 1986 forest plan has limits for open motorized access density (OMAD), total motorized access density (TMAD), and secure core providing high levels of habitat security for elk during all seasons in all but the Salish Mountains Geographic Area. In the Salish Geographic Area, the current forest plan addressed elk security by specifying the maximum density of roads open to public motorized vehicle use for smaller geographic units (see figure B-65 and discussion under grizzly bears) and by applying site-specific elk security guidelines at the project level. As explained in the Forest Plan Assessment, these actions support key ecosystem characteristics for elk and the Forest's elk hunting districts are currently meeting objectives identified by MFWP for balancing elk populations and hunter access (Assessment of the Flathead National Forest 2014; parts 1 and 2).

The 1986 forest plan includes management area direction for roaded and unroaded lands providing elk winter habitat (MA 13 areas). Direction includes: 1) preparation of a long-range activity schedule for each winter range to provide the size, age, diversity, and distribution of habitat needed by these species when implementing habitat improvement projects; and 2) maintaining at least 30 percent winter thermal cover. MA13 areas that are steep and have sparse tree cover are listed as not suitable for timber production, while more heavily timbered winter habitat areas are listed as suitable for timber production. MA 13 also includes direction to close key winter range areas to motorized over-snow vehicle use if there are conflicts. These actions are coordinated with MT FWP and other private cooperators (e.g. Rocky Mountain Elk Foundation) to support elk populations that use Forest lands.

Environmental consequences alternatives B, C, and D

With the action alternatives, a winter range MA specific to elk/mule deer was not designated. Desired conditions for the warm-dry and warm-moist biophysical settings that maintain snow intercept cover for white-tailed deer would also maintain canopy cover in forested areas where elk/mule deer winter habitat overlaps with white-tailed deer winter habitat. Steep open areas providing elk/mule deer winter habitat are generally mapped as MA6a (areas not suitable for timber production) under all alternatives, so timber harvest would not be expected to affect elk winter habitat.

Key ecosystem characteristics for mule deer and elk habitat during all seasons, described in the affected environment, would be supported by implementation of plan components for watersheds and RMZs as well as vegetation structure, composition, and pattern. Habitat types providing moist sites used by elk and mule deer during the non-winter seasons are generally found in the cool-moist and cold biophysical settings. Most of the acreage in these biophysical settings is mapped as lynx habitat, with standards that promote high understory density and cover, but limit timber harvest and thinning activities that create openings providing elk forage. However, in areas where wildfires occur, forage for elk is abundant.

Habitat security for elk and mule deer is maintained by management direction for the grizzly bear because this direction creates areas that are at least 2,500 acres in size more than about 0.3 miles from bermed roads in the grizzly bear PCA (see figure B-1). In the grizzly bear zone 1 (which encompasses most of the rest of the Forest) standard GA-SM-STD-01 specifies that the linear density of roads open to public motorized vehicle use on NFS lands is limited to the baseline, continuing the conditions which support MFWP objectives. With alternative C, there is additional MA1b (recommended wilderness) and an additional limit on motorized access for trails open to public motorized use in the Salish demographic connectivity area, providing an even higher level of habitat security for elk, but less motorized access for hunters. All action alternatives include a site-specific guideline to provide elk security in proximity to key habitats during key seasons (e.g., winter habitats) in the Salish GA (Guideline GA-SM-GDL-01).

In winter habitats, areas and trails are located to minimize harassment of elk and mule deer or significant disruption of their winter habitats. Areas suitable for motorized over-snow use vary by alternative. With alternatives B, C, and D an area of the North Fork geographic area would become suitable for motorized over-snow use that is not currently suitable. This change affects less than 1000 acres of mapped elk winter habitat, (as displayed in figures 1-27 to 1-30). This addition would have a minor effect on elk because the the majority of winter habitat in the North Fork is not open to motorized over-snow vehicle use.

Cumulative consequences

In northwest Montana, the combined effects of multiple predators could exert greater and more consistent predation pressure on elk and mule deer compared to other environments with fewer effective deer predators (Mackie et al. 1998). With respect to mortality, predation may act in concert with winter weather (Brodie et. al. 2013).

Valley-bottoms where elk and mule deer winter are expected to have warmer winters on average, which may be beneficial for elk and mule deer, but there is uncertainty about precipitation levels. In addition, there may be high levels of weather variability from year-to-year, leading to greater fluctuations in elk and mule deer populations. State and some private land management provides diversity which benefits mule deer and elk, provided road access is managed. In the past few decades, there has been an increase in road closures on all lands. Timber harvest and habitat improvement projects on all lands have also supported elk and mule deer populations by creating diverse conditions (see Vegetation section of this DEIS for more details). Since the late 1980s, close to 40,000 acres on NFS lands have had habitat improvement projects benefiting elk and mule deer habitat, including prescribed burns, planting, slashing of small conifers to maintain forage openings, and weed control (also see section of Flathead National Forest Assessment 2014).

Climate change is expected to increase the frequency of summer drought and increase fire size and severity. Drought may cause moist vegetation to dry up sooner, decreasing forage quality. In addition, areas burned by high severity fires provide a seed bed for invasive weeds which do not provide forage for elk and deer (NRAP 2015). The Forest has experienced an increase in wildfires in areas providing elk habitat in the last few decades (see Forest Assessment 2014), creating an increase in the quality and quantity of noon-winter forage, especially in the North Fork, Hungry Horse, and South Fork Geographic Areas. This trend has also occurred on lands in Glacier National Park.

MFWP manages both mule deer and elk populations through hunting regulations, adjusting regulations to meet population and harvest objectives. Glacier National Park, encompassing about a million acres adjacent to the Forest, is closed to hunting. A downward trend in the mileage of roads open to motorized use year-round and during the hunting season has helped to maintain elk and mule deer habitat security on all lands. In addition to Forest lands, there are many closed roads on DNRC and private forest lands. This has increased non-motorized hunting opportunity, but has reduced motorized hunting opportunity. MFWP reported on Elk Population Objective Status by Hunting District in 2013, and for elk hunting districts with identified objectives, all those on the Forest (including all lands) are “at objective” levels (see elk section of Flathead National Forest Assessment 2014 for more details).

In summary, the cumulative effects of proposed management actions on the Forest, in the context of all lands of the larger landscape, contribute to the ecological integrity of habitats that support mule deer and elk. This would be accomplished by plan components promote a vegetation mosaic and control motorized access. While the Forest does not have authority over all stressors that may affect mule deer and elk, the Forest contributes to the ecological conditons that support them.

Moose

Key indicators for analysis

The public expressed an interest in this species during scoping. Most effects to moose are addressed by the indicators and effects of alternatives described under “wildlife associated with aquatic, wetland and riparian habitats”, “coniferous forest habitats in a variety of successional stages”, and “mule deer and elk”. Some of the cumulative consequences to moose are different, as described below.

Affected environment

Moose population, life history, habitat, and distribution: Moose are distributed across most of Alaska, Canada, and the northern tier of the U.S. Moose are of interest for hunting and observing and for subsistence by the Confederated Salish and Kootenai Tribes. Moose populations have been largest in MFWP Region 1 (northwest Montana) and 3 (southwest Montana), where moose populations increased and expanded in range through the early 1990s. This is believed to be due to prevalence of early successional forest created by fire and timber harvest (Brown 2006). Since the 1990's, aerial survey trends and hunter harvest statistics indicate populations in Montana appear to have declined, but much uncertainty about the significance and causes of apparent trends are unknown (Smucker et al. 2011). Potential limiting factors to moose populations were identified as hunting harvest, predation, vegetative succession and degradation, parasites, and climatic conditions (DeCesare et al. 2014). In 2013, Montana Fish, Wildlife, & Parks (MFWP) began a 10-year study designed to improve understanding of means to monitor the current status and trends of moose populations as well as the relative importance of factors limiting population growth. http://fwp.mt.gov/fishAndWildlife/diseasesAndResearch/research/moose/populationsMonitoring/. The Cabinet-Fisher portion of the study area has habitat most similar to habitat on the Forest. In the first two years of the study, moose in the Cabinet-Fisher study area had the lowest calf-survival rate of the 3 Montana study areas, but the highest adult survival rate (DeCesare and Newby 2015).

Moose are distributed across the Forest in summer. In winter moose are primarily found in the Salish and Hungry Horse Geographic Areas of the Forest (for more details see Assessment for the Forest, 2014). In summer, high quality moose habitat is provided by shrubs (e.g.willow, alder, red-ozier dogwood, pachistima) that occur in a variety of riparian areas, as well as burns and harvest areas. Aquatic and riparian areas are key in summer, when moose may move from high elevation habitats where they feed upon shrubs, to low elevation feeding sites where they feed upon aquatic plants (Matchett 1985). In some parts of the western United States, cottonwood/willow riparian habitats have been reduced by as much as 90‑95% (Johnson and Carothers 1982 IN DeCesare et al. 2014). Historically, persistent riparian habitat along rivers and streams may have provided long-term stability to moose populations and functioned as corridors to allow moose to expand into post-fire habitats (Peek 2007 IN DeCesare et al. 2014). Moose frequently use both logged and burned forest habitat in the first 10 to 30 years after harvest or fire (Eastman 1974 IN Smucker et al. 2011, Telfer 1995, Brown 2006). In the Yaak River drainage of northwest Montana, moose selected for clearcut areas that had been logged 15–30 years prior as well as areas within 100 meters of a cutting unit (Matchett 1985). If deep, soft snow has accumulated, moose use forested riparian areas and other areas of mature forest, feeding upon species such as Pacific yew beneath the canopy. By late winter and early spring, when the snow crusts over, moose may move up in elevation and feed on deciduous shrubs in openings. Unlike elk, moose do not avoid roads or motorized use and do not appear to select cover for travel (Matchett 1985). Individual moose may be more vulnerable to hunter harvest in areas of high road density, however, allowable harvest levels are set by MFWP. Moose are known to travel on roads or compacted snowmobile trails in winter.

Key Stressors under USFS control

Vegetation management: If not managed appropriately, vegetation and fire management can decrease habitat diversity and excessive open road density increase accessibility for harvest.

Key Stressors not under USFS control

Hunting: Moose are hunted under a permit drawing system regulated by MFWP and the CSKT also have treaty rights to hunt moose. All or portions of about 7 moose hunting districts occur on the Forest. The number of moose permits in Region 1 was gradually doubled between 1983 and 1995. Between 1995 and 2010, the number of moose permits issued in Montana was reduced by 40 percent, with most of this reduction occurring in Regions 1 and 3. The highest moose harvest has been in the Salish, North Fork, and Hungry Horse GAs.

Parasites: While data are not available on the impact of ticks on moose in Montana, negative effects of ticks on moose populations have been well documented elsewhere and the impacts of ticks on moose in Montana seem likely (DeCesare et al. 2014).

Predation: Young and old moose may be susceptible to predation by wolves and bears (Kunkel and Pletscher 1999).

Climate change: DeCesare and Newby's 10-year study summarizes effects of climate change. Moose have a northern distribution, but the factors that define the southern limits of their current distribution are not well understood (Lowe and others 2010). Within Montana it is unclear whether any climatic variables underlie spatial variation in the productivity of local populations (DeCesare et al. 2014). The 2015 annual report on moose research in Montana summarized what is known about moose and climate as follows.

Moose are well adapted to cold temperatures and have been shown to modify their movements and habitat use if they become heat stressed. There is scientific disagreement on effects of climate change on survival. Climate and weather conditions can directly and indirectly influence moose populations (Karns 2007, Van Ballenberghe and Ballard 2007 *IN* DeCesare and Newby 2015). Climatic patterns determining the timing of spring green up, summer precipitation and winter snow conditions can influence survival and recruitment indirectly through effects on forage availability and quality (Van Ballenberghe and Ballard 2007, Brown 2011 *IN* DeCesare and Newby 2015) and through climate-mediate effects on parasite densites, such as winter ticks (Samuel 2007 *IN* DeCesare and Newby 2015). Direct effects of climate on moose can be seen in their metabolic response to temperatures (Renecker and Hudson 1986) and the energetic costs of traveling through deep snow *IN* DeCesare and Newby 2015).

Summary of Alternative Consequences

With all alternatives, plan components for RHCAs or RMZs and coniferous forests would support key ecosystem characteristics for moose habitat. Diverse forest structure and composition would be promoted by timber harvest, commercial and pre-commercial thinning, and prescribed burning to meet desired conditions.

Environmental consequences Alternative A

The no-action alternative has an objective to provide sufficient habitat to contribute to meeting the objectives of MT FWP management plans. This would primarily be provided by timber harvest.

Environmental consequences Alternatives B, C, D

FW-DC-TE&V-19 states that forests in the cool-moist and cold biophysical settings provide habitat for a variety of wildlife species (see Appendix D for a full list of species). Processes (e.g. fire, wind, insects and disease) that create diverse patches and patch sizes also create openings dominated by grasses, forbs and shrubs providing non-winter foraging habitat for wildlife species (e.g. a wide variety of plant species that produce berries for grizzly bears, species such as willow, alder, or yew that provide cover and forage for snowshoe hares and moose). Modelled effects of alternatives are very similar to those described in the section for elk/mule deer, hardwood trees, and aquatic, wetland, and riparian habitats.

Cumulative Consequences

Many of the cumulative consequences are the same as those listed for white-tailed deer, elk, and mule deer. Past timber harvest on NFS lands as well as private and state lands has been beneficial to moose by creating open shrub habitats favored for feeding. An increase in wildfire on NFS and Glacier National

Park lands in recent decades has been beneficial to moose for the same reasons. Wildfires are expected to continue to provide forage for moose in the future.

In general, moose are a cool and cold climate species. In the future, increases in temperature associated with climate change could directly stress moose or make them more susceptible to other mortality factors, but there is currently a high level of uncertainty with respect to climate effects on moose. The effects of climate, parasites, and predation on moose in Montana is currently being investigated.

MFWP manages moose populations and is likely to continue to adjust the number of permits as more is learned about moose population trends in northwest Montana. Glacier National Park, encompassing about a million acres adjacent to the Forest, is closed to hunting, but has high levels of predators.

In summary, the cumulative effects of proposed management actions on the Forest, in the context of all lands of the larger landscape, contribute to the ecological integrity of habitats that support moose. This would be accomplished by plan components promote a vegetation mosaic and control motorized access. While the Forest does not have authority over all stressors that may affect moose, the Forest contributes to the ecological conditons that support them.

Gray Wolf

Key indicators for analysis

The public expressed an interest in this species during scoping. Wolves are habitat generalists, with habitat needs that are largely provided by coniferous forest habitat diversity. Management direction that supports their ungulate prey species (also see sections of chapter 3 on moose, deer, and elk) and provides habitat security (also see grizzly bear section of chapter 3) supports wolves. In addition, the following species-specific indicators are relevant to the gray wolf.

Management direction to promote key ecosystem characteristics of wolf habitat and reduce the risk of human disturbance near active wolf den and rendezvous sites.

Affected environment

Population, life history, habitat, and distribution: The gray wolf is distributed across most of Alaska, Canada, northern Minnesota and Michigan, and throughout the Rocky Mountains including western Montana. Wolves are of interest for hunting, trapping, and observing. The gray wolf was delisted in Montana and Idaho in May of 2011, with hunting and/or trapping of wolves under state management occurring soon after. According to the USFWS, as of the end of 2013, the Northern Rocky Mountain wolf population had exceeded its recovery goals since 2002 (Service Review of the 2013 wolf population in the NRM DPS, April 21, 2014; obtained May 2014 http://www.fws.gov/mountainprairie/species/mammals/wolf/NRM_DPS_2013_Review.pdf).

Montana wolf pack territories are large and change from year to year, depending on prey availability and relationships with neighboring packs (Bradley et al. 2014). As of 2014, the number of wolf packs within or adjacent to the Forest was well above the targeted recovery level and they were distributed across the Forest. In 2014, MFWP verified a minimum count of 338 wolves and 17 breeding pairs in the Montana portion of the Northwest Montana (NWMT) recovery area, compared to 412 wolves and 15 breeding pairs in 2013 (Bradley et al. 2015). Gray wolves commonly hunt in packs. Main prey items in Montana include deer, elk, and moose. Domestic livestock such as cattle and sheep are also preyed upon. Gray wolves may also eat alternative prey, such as rodents, vegetation, and carrion (MFWP 2003).

Pack activity is centered on the den site where pups are born and nearby rendezvous sites where pack members convene from late April until September. Boyd-Heger (1997) found that wolves in the North

Fork Flathead River drainage appeared to select denning and rendezvous sites that had relatively low elevation, flat terrain, and were close to water. The wolf recovery plan stated that key components of wolf habitat are: 1) a sufficient, year-round prey base of ungulates and alternative prey, 2) somewhat secluded denning and rendezvous sites, and 3) sufficient space with minimal exposure to humans at a landscape scale (USFWS 1987). Gray wolves establishing new packs in Montana have demonstrated greater tolerance of human presence and disturbance than previously thought characteristic of this species (Montana Fish, Wildlife and Parks 2003).At a landscape scale, the gray wolf exhibits no particular habitat preference except for the presence of native ungulates (deer, elk, moose) within its territory on a year-round basis. Ungulate winter ranges, usually located in valley bottoms, are key for wolf survival.

Wolves are less abundant in areas of high open road and trail density (Whittington, St Clair, and Mercer 2005), likely due to higher human-caused mortality in these areas. With respect to habitat connectivity, forest roads are not a barrier and wolves often travel on closed roads (K. Laudon, MFWP pers. comm. 2011). Many miles of roads on the Forest have been closed in recent decades, providing habitat security for wolves (see grizzly bear section of Chapter 3 for more details).

At a landscape scale, the USFWS conducted a multi-scale assessment for the Northern Rocky Mountain segment of the gray wolf population in 2009 **(**Federal Register /Vol. 74, No. 62 /Thursday, April 2, 2009 /Rules and Regulations *IN* Federal Register/Vol. 76, No. 87/Thursday, May 5, 2011/Rules and Regulations). This assessment stated, “There is more than enough habitat connectivity between occupied wolf habitat in Canada, northwestern Montana, and Idaho to ensure exchange of sufficient numbers of dispersing wolves to maintain demographic and genetic diversity in the NRM wolf metapopulation. We have documented routine movement of radio-collared wolves across the nearly contiguous available suitable habitat between Canada, northwestern Montana, and central Idaho. Wolf dispersal into northwestern Montana from the more stable resident packs in the core protected area (largely the North Fork of the Flathead River along the western edge of Glacier NP and the few large river drainages in the Bob Marshall Wilderness Complex) and the abundant National Forest Service lands largely used for recreation and timber production rather than livestock production, helps to maintain this segment of the NRM wolf population.”

Key stressors **under USFS control**

Land management: The effect of land management on wolves is primarily by effects on wolf prey and security near den sites.

Key stressors not under USFS control

Removal of wolves or wolf packs due to livestock conflicts: Livestock conflicts most often occur with sheep. There are no sheep grazing allotments or permits on NFS lands. Sheep are grazed on some private lands in the Flathead Valley.

Hunting or trapping: Gray wolf populations are managed by Montana Fish, Wildlife and Parks as directed by the Montana Gray Wolf Conservation and Management Plan, Amended ROD, May 2004.

Climate change: Projected climate changes could result in negative, neutral or positive impacts to habitat for the gray wolf and would be strongly influenced by effects to the species wolves prey upon (see sections on white-tailed deer, mule deer/elk, and moose for more details).

Summary of alternative consequences

Wolves are wide-ranging habitat generalists. Plan components to provide a sustainable mosaic of forest conditions would support key ecosystem characteristics for wolves and their prey species. With all alternatives, plan components for the grizzly bear would provide habitat security for wolves, as would specific plan components to reduce human disturbance at wolf den and rendezvous sites, described below.

Environmental consequences alternative A

The 1986 Forest Plan provides forestwide management direction specific to the gray wolf, which contributes to habitats that support wolves. Management direction specific to wolves includes timing limitations for timber harvest near dens and rendezvous sites. Implementation of big game management direction benefits wolves by providing habitat conditions to support wolf prey species. Implementation of Amendment 19 benefits wolves by providing security for wolves and their big game prey species and also reduces the risk of wolf mortality.

Environmental consequences alternative B, C, D

Key ecosystem characteristics described in the affected environment would be supported by implementation of plan components for watersheds and RMZs as well as plan components for diverse vegetation included in all action alternatives. In addition, grizzly bear standards would maintain baseline open and total road densities and secure core, providing secure habitat for wolves and reducing the risk of excessive wolf mortality. Plan components would also benefit wolf prey species (for more details see the sections on white-tailed deer, mule deer/elk, and moose). Guideline FW-GDL-SOI-WL-02 provides direction to limit disturbance within ¼ mile of known, active dens and rendezvous sites, incorporating measures to avoid or mitigate impacts of activities from mid-March to July. The distance from active den and rendezvous sites is less than with Alternative A, but is expected to have minor effects because wolves have been found to be more tolerant of human activities than previously thought (Montana Fish, Wildlife and Parks 2003). In order to protect wolves, wolf den sites are not mapped, but the USFS coordinates with MFWP to gather information on known den and rendezvous sites.

Cumulative consequences

MFWP manages wolf populations through trapping and hunting regulations, adjusting regulations to meet population and harvest objectives. Glacier National Park, encompassing about a million acres adjacent to the Forest, is closed to hunting and trapping. Elsewhere, wolf hunting and trapping has been allowed from 2011–2015. The minimum known wolf population dropped from about 650 in 2011 to about 536 and 32 breeding pairs in 2015, but was still well above the target population of 10 breeding pairs for 3 consecutive years established for recovery. In the future, the wolf population may see a decreased growth rate or see a population decline, but hunting and trapping have not kept wolf populations from exceeding recovery goals.

Human-wolf conflicts can occur when wolves prey upon livestock, sometimes leading to removal of individual wolves or packs. Because grazing has been very limited on the Forest as well as on state and private lands in recent decades, only one wolf pack has been removed due to past livestock conflicts. On NFS lands, limits on livestock allotments adopted for the grizzly bear would also benefit wolves.

Timber harvest occurring on private, state, or other lands may affects the distribution, amount, and quality of ungulate habitat or cause disturbance to wolves. The wolf population in northwest Montana increased exponentially while these activities were going on within their habitat, so it is unlikely there have been any substantial effects. Access management has trended towards reducing the miles of open roads and so has improved wolf habitat security and likely decreased mortality on NFS lands as well as on state and some private timber lands. Glacier National Park provides a high level of wolf security and has very few miles of roads. The desired condition for connectivity in the revised Forest Plan directs the Forest to work with other agencies and landowners when highways are proposed for construction or reconstruction to incorporate crossing structures where needed. This should aid in minimizing the risk of vehicle collisions with wolves or their prey and would also aid in maintaining connectivity between areas of NFS lands as private lands are subdivided in the future (also see sections of Chapter 3 on moose, elk, deer, and grizzly bear).

Because wolves and their prey are habitat generalists, changes in climate are expected to have a minor effect on their habitat. Moose may be more sensitive to other effects of climate change and are currently being studied in Montana (see sections of Chapter 3 on moose, elk and deer).

In summary, the cumulative effects of proposed management actions on the Forest, in the context of all lands of the larger landscape, contribute to the ecological integrity of habitats that support wolves. This would be accomplished by plan components promote a vegetation mosaic, control motorized access, and limits activites near den and rendezvous sites during key time periodss. While the Forest does not have authority over all stressors that may affect wolves, the Forest contributes to the ecological conditons that support them.

Northern Goshawk

The public expressed an interest in this species during scoping. In additional to coarse filter plan components for coniferous forests, the following species-specific indicator applies to the goshawk:

- Management direction to promote key ecosystem characteristics of goshawk habitat and reduce the risk of human disturbance near known active nest sites

Affected environment

Population, life history, habitat, and distribution: The goshawk is a breeding resident across most of Alaska, Canada, and the western U. S. A 2005 survey effort across road-accessible NFS lands in the Northern Region estimated goshawks were present in 39% of the territory-sized sample units (95% CI = 29% - 50%; Kowalski undated). Although the survey design did not estimate goshawk occupancy rates for any individual National Forest, it did indicate that goshawks were fairly common and widely distributed across managed areas of USFS Region 1, including the Flathead National Forest. Presence of the northern goshawk has been reported on the Flathead National Forest, with 44 “positive” observations recorded from 1982 to 2000 (including observations of nests and young), and numerous observations reported from 2000-2010 (see planning record exhibit V-43). It is a large, territorial bird that is distributed across all Forest geographic areas (GAs).

In their status review of northern goshawk, the U.S. Fish and Wildlife Service found that the goshawk typically uses mature forests or larger trees for nesting habitat (the nest area); however, it is considered a forest habitat generalist at larger spatial scales (USFWS 1998). The Service found no evidence that the Goshawk is dependent on large, unbroken tracts of “old growth” or mature forest (63 FR 35183 June 29, 1998). However, nest areas include forests with a narrow range of structural conditions (Reynolds et al. 2008, Squires and Reynolds 1997). Goshawks generally select stands based on structure, but selection varies by forest type. For example, in lodgepole pine stands, canopy closure ranged from a mean of 34 to 80 percent and a tree size ranged from 9 to 15 inches d.b.h. Hayward and Escano (1989) found that nest sites in mixed species stands of northwest Montana were often located in stands that supported widely-spaced large trees. Squires and Kennedy (2006) found that nest areas are usually mature forests with medium to large trees, canopy closure of 60 to 90 percent, and an open understory (Squires and Kennedy 2006). On the Forest, nests have also been found in more dense mixed species stands where there is a break in the topography or canopy.

Goshawks use large landscapes, integrating a diversity of vegetation types to meet their life-cycle needs (Squires and Kennedy 2006). The average patch size of core nesting areas varies according to available habitat conditions, but averaged 40 acres in west central Montana (Clough 2000). The post-fledging area (PFA) of 200-500 acres is defined as the area used by the family group from the time the young fledge until they are no longer dependent on the adults for food (Reynolds et al. 1992). In warm and dry forest communities, reducing tree densities by "thinning from below" may reduce forest fuels while simultaneously creating stand conditions that are favorable for goshawk foraging (Reynolds et al.1992, Squires and Kennedy 2006).

Key Stressors under USFS Control

Land management: This species may be negatively affected by timber harvest or associated disturbance too close to nesting sites, or by fire suppression that creates forest structure that is too dense for hunting.

Key Stressors Not under USFS Control

Land management: On non-FS lands, this species may be negatively affected by timber harvest or associated disturbance too close to nesting sites, or by fire suppression that creates forest structure that is too dense for hunting.

Climate change: Goshawks are habitat generalists that are not expected to be sensitive to climate change. Effects of climate change on goshawks could be positive, negative, or neutral, depending upon scale.

Summary of Alternative Consequences

All alternatives have plan components that would support key ecosystem characteristics for goshawks including large and very large trees used for nesting and open understory conditions for hunting (see the Vegetation section of DEIS Chapter 3 and the sections below on wildlife associated with old growth habitat, very large live and dead trees for more details). Diverse forest structure and composition to support post-fledging habitats used by goshawks would be affected by timber harvest, commercial and pre-commercial thinning, wildfire, insects and disease, and prescribed burning to meet desired conditions. The mix of activities varies by alternative, as described below.

In order to assess key aspects of habitat for goshawk nesting habitat, effects of alternatives on NRV, current conditions, and effects of alternatives were modeled by Ecosystem Research Group (Appendix 3). The natural range of variation (NRV) was modelled going back about 1000 years and effects of alternatives were projected for the next 50 years, including anticipated changes in climate and the fire suppression logic of the model.

The model predicts all alternatives would stay within the minimum and maximum range of NRV over the 5 decade time period. Goshawk nesting habitat was modelled based upon habitat type group, including tree size classes greater than 10" d.b.h. and canopy cover greater than 40% (Greenwald et al. 2005) . The northern goshawk habitat model is limited to nesting habitat because it is assumed that post-fledging and foraging habitat is not limiting (Brewer et al. 2007; Kennedy 2003). Acres of nesting habitat increase to near maximum NRV in the first two decades and then decline substantially to near the minimum NRV by the 5th decade. The combined acreage of large and very large trees (used to model goshawk nesting habitat) increases slightly through the 5-decade period, therefore, the decline is not because large trees are limited, but rather because modelled stands will become too open to provide nesting habitat (i.e. less than 40% canopy closure). Vegetation modeling results suggest that forestwide there would be an upward trend in the large tree size class, but a downward trend over the next five decades in the very large tree size class. The warm dry and warm moist biophysical settings show an upward trend in the very large tree size class, but the cool moist moderately dry setting shows a downward trend (refer to forest size class in the vegetation section of DEIS Chapter 3). The combination of increased fire, insects, and disease is resulting in a substantial decline in modelled canopy closure (which reduces goshawk nesting habitat quality and quantity but may increase foraging habitat quality and quantity). Because alternatives B and D provide slightly less modelled nesting habitat (10,000 acres) than alternatives A and C, timber harvest also likely plays a role in reduced canopy closure.

This modeled outcome estimates acres of nesting habitat with no consideration for distribution across the landscape. For that reason, modeled levels of nesting habitat may have little relationship to the actual density of nesting goshawks. Goshawks are highly territorial and can nest in relatively small, isolated parcels of nest habitat (Reynolds et al. 1991). Research has also shown that landscapes fragmented by timber harvest support nest densities comparable to un-fragmented landscapes as long as nest habitat persists at levels sufficient to support goshawks at maximum densities based on territoriality (Clough 2000). While the modeled nesting habitat declines over the five decades, it remains within the NRV, suggesting habitat sustainability regardless of alternative selected.

Environmental Consequences Alternative A

The 1986 plan does not have management direction specific to goshawks, but does have standards to maintain existing old growth.

Environmental Consequences Alternatives B, C, D

In summary, plan components would support key ecosystem characteristics for goshawks because: 1) all alternatives retain existing old growth (FW-STD-TE&V-02), 2) all alternatives have forest plan direction that provides for retention of larger diameter live trees and other key stand structural components that would contribute to future old growth development within harvest units (FW-STD-TE&V-4; FW-GDL-TE&V-9, 10, 11, 12), 3) all alternatives focus on stand conditions that would make old growth forests more resilient in a changing climate, and 4) activities known to disrupt goshawks would be restricted during the nesting season in 40+ acre stands containing known nest sites (Guideline FW-GDL-WL SOI-04), thus reducing the risk of disturbance.

Cumulative Consequences

In the past, regeneration harvest likely resulted in loss of goshawk nesting habitat on NFS lands as well as state and private timber lands. In the future, goshawk habitat could be negatively impacted by loss of large trees for nesting on all lands if drought, insects/disease, or stand-replacing wildfires are extensive and frequent in the future, but habitat suitable for hunting of prey species may be increased by wildfires. Future effects due to timber harvest as well as climate changes would depend upon distribution across the landscape, which cannot be predicted. Because goshawks are highly territorial, their nesting density is naturally low. They can nest in relatively small, isolated parcels of nest habitat and research has shown that landscapes fragmented by timber harvest support nest densities comparable to un-fragmented landscapes. Goshawks are highly mobile and are likely to be able to find sufficient nesting habitat.

In summary, the cumulative effects of proposed management actions on the Forest, in the context of all lands of the larger landscape, contribute to the ecological integrity of habitats that support goshawks. This would be accomplished by plan components promote retention of old growth habitat, very large live trees, a vegetation mosaic, forest resilience, and limits activites near active nest sites during key time periodss. While the Forest does not have authority over all stressors that may affect goshawks, the Forest contributes to the ecological conditions that support them.

Marten

Key indicators for Analysis

The public expressed an interest in this species during scoping. In additional to coarse filter plan components for coniferous forests, all alternatives have standards or guidelines for old growth, very large live and dead trees >20 inches d.b.h., snags < 20 inches d.b.h., and large down woody material which provide key ecosystem characteristics for marten. In addition to plan components for the warm-moist and cool-moist biophysical settings discussed in the vegetation section of Chapter 3, the following species-specific indicator applies to marten:

- Management effects key ecosystem characteristics providing cover and habitat connectivity for marten

Affected Environment

Population, life history, habitat, and distribution: Marten are distributed across most of Canada, the Rocky Mountains, the Great Lakes region, and portions of the Pacific coast region. Marten are of interest for observing as and trapping. Marten populations fluctuate in response to prey availability, juvenile dispersal, and mortality of adult females. Population parameters indicate a relatively stable or slightly declining population on a statewide basis (Giddings 2009). There is speculation that trapper access to public lands has decreased over time from route and area closures to protect other species. Marten are distributed across western Montana, including all Forest GAs, with recent trapping records, observations, or verified hair samples from non-invasive monitoring in the last 10 years.

The literature uses a variety of terms for describing marten habitat including mature forest, mid-to-late successional forests, and late seral forest. Very few studies have defined average diameters associated with these descriptions. When citing the literature, the terms used by various authors are retained. However, in describing the current condition on the Forest and when comparing the alternatives, a consistent set of terms and their definitions will be described.

Marten are "subnivean" foragers (Ruggiero et al. 1994) well suited to deep snow conditions. Similar to lynx, marten are often associated with mixed spruce-fir forests during winter (Koehler and Hornocker 1977). Mesic forests support the greatest understory plant species diversity and the greatest vole populations, the primary prey species for marten in many areas (Koehler and Hornocker 1977). According to Buskirk and Powell (In: Ruggiero et al 1994) and Tomson (1998) American martens are closely associated with late successional, mesic forests, with an abundance of snags, coarse, woody debris or low shrubs and small understory trees. Complex physical structure near the ground provides refuge sites, access to prey, and a protective thermal environment (Buskirk and Ruggiero 1994). In summer marten may also use young forests where coarse, woody debris is abundant, although they may be more vulnerable to predation in young forests (Baker, In: Ruggiero et al 1994, Tomson 1998). Marten appear closely associated with forest conditions, and tend to avoid edges or openings (Koehler and Hornocker, 1977). Tomson (1998) suggested martens are at increased risk from avian predators and coyotes in openings. Tomson (1998) found that while 28% of his relocations were in non-forest openings, all were less than about 525 feet from adjacent, similar to the findings of Soutiere (1979 In: Allen 1982) that marten seldom cross openings greater than about 540 feet. Snyder and Bissonette (1987 In: Ruggiero et al 1994) concluded that the ability of martens to utilize mature/old stands in a logged landscape was dependent on patch size, and that martens avoided patches less than about 40 acres. Ruggiero and others (1994) caution managers that the "dearth of knowledge in this area makes managing forested landscapes for martens highly conjectural."

On the Forest, some portions of the forest have large openings due to stand replacing wildfire. A high percentage of the South Fork Flathead River and North Fork Flathead River GAs have been burned by wildfire in recent decades (18.7 and 20 percent, respectively), while a low percentage of the Swan Valley and Salish Mountains GAs has been burned by wildfire (2.6 and 2.7 percent, respectively). Regeneration harvest also reduces cover. The Salish Mountains GA has the highest percentage recently harvested (8.5 percent) while the Middle Fork GA has the lowest (0.1 percent) (see Assessment of the Forest 2014 for more details). Except in portions of the Swan Valley and Salish Mountains GAs where whole sections totaling 640 acres have been harvested in recent decades, regeneration harvest has generally created smaller openings and had less impact on cover providing connectivity than wildfire.

Key stressors under USFS control

Land Management: Timber harvest and fire management affect marten habitat by creating a variety of successional stages and forest structures, in a variety of patch sizes, providing diverse habitats for marten and their prey. However, land management can also reduce cover and habitat connectivity.

Key stressors not under USFS control

Climate change: Increased drought and associated wildfires resulting from a warmer, drier future climate may have detrimental effects on marten habitat. Marten are known to make low use of burns during the first 10 years after fire. Low marten abundance in areas of high severity fires can persist for up to about 75 years, but after about 75 years, marten are abundant in burned areas (Fisher and Wilkinson 2005).

Mortality due to trapping: Marten populations are managed by Montana Fish, Wildlife and Parks.

Summary of alternative consequences

All alternatives adopt the vegetation standards of the Northern Rockies Lynx Management Direction, which also benefits marten because these two species both use forests in the cool-moist and a portion of the warm-moist biophysical settings (figures B-10 forestwide, or B-11 to 16 by geographic area). In addition, plan components for snags and down woody material, listed in the sections below on “wildlife associated with old growth habitat and very large live and dead trees” and “wildlife associated with dead trees <20” dbh” would benefit marten by providing for the habitat structure they need for denning, hunting, and resting. Diverse forest structure and composition would be promoted by timber harvest, commercial and pre-commercial thinning, wildfire, insects and disease, and prescribed burning to meet desired conditions. The mix of activities varies by alternative, as described below, but all would support key ecosystem characteristics of marten habitat.

In order to assess key aspects of habitat for goshawk nesting habitat, effects of alternatives on NRV, current conditions, and effects of alternatives were modeled by Ecosystem Research Group (Appendix 3). The natural range of variation (NRV) was modelled going back about 1,000 years and effects of alternatives were projected for the next 50 years, including anticipated changes in climate and the fire suppression logic of the model.

Modelled marten habitat included all but the warm-dry and cold biophysical settings. Marten habitat was modelled as coniferous forests with an average tree diameter of at least 10 inches d.b.h, and a canopy cover class of at least 40 percent. The model predicts all alternatives would stay within the minimum and maximum range of NRV over the 5 decade time period. There is a very wide range of variation between maximum and minimum NRV; about 650,000 acres.

In the future, acres of modelled habitat initially increases for all alternatives, with a level near the maximum NRV, likely due to the fire suppression logic used by the model and forest succession outpacing fire, insects, disease and vegetation management treatments. Then acres of modeled habitat declines substantially, returning to levels around 25% below current with all alternatives. The modeled decline in habitat is steeper than for fisher, likely the result of marten occupying higher elevation habitats than fisher. The model is this case is likely predicting that fires in upland habitats burn more acres at higher severities than lower elevation mesic habitats. Because the marten requires denser stands than the fisher, the combination of increased fire, insects, and disease is resulting in a substantial overall decline in modelled canopy closure which reduces marten habitat quality and quantity.

Environmental consequences alternative A

The 1986 Forest Plan did not have management directions specific to marten, but Amendment 21 supports habitat requirements for marten, as discussed in the section on old growth habitat, very large live and dead trees.

Environmental consequences alternatives B, C, D

Alternatives B, C and D have plan components for fisher and lynx that would also benefit marten by providing for a mix of successional stages to provide for foraging and denning, cover to avoid predation, and complex structure near the ground surface to support their sub-nivean foraging habits.

Cumulative consequencess

On all lands, a proportion of the mid-successional forest and the medium tree size class will advance into a late successional or large tree size class as natural succession progresses over time (see Vegetation section of Chapter 3 for more details). However, ecosystems are dynamic and constantly changing, so timber harvest and/or stand-replacing wildfires (which are characteristic of the cool-moist biophysical setting) could be expected to alter or remove existing mid and late successional forests in the future. Insects or diseases may also kill the older, larger trees, which are often the most susceptible to infestation and mortality. These dead trees would then become snags and down logs, an important component of marten habitat. On lands in Glacier National Park, adjacent to the forest, trees would not be salvaged after fire, except to provide for human safety. On private and state lands, dead trees are more likely to be removed.

MFWP manages marten populations through trapping regulations, adjusting regulations to meet population and harvest objectives. Glacier National Park, encompassing about a million acres adjacent to the Forest, is closed to trapping.

Coniferous forest connectivity

Connectivity of cover was modelled for marten, but also applies to numerous other species. Public comments on Forest Plans, wilderness legislation, or individual projects often suggest that the establishment of large, permanent reserves of late seral forest be provided for habitat connectivity. Such permanent reserves may indeed provide long-term habitat when located within disturbance regimes where natural disturbances are infrequent or occur at very small scales. However, within the Northern Rockies, natural, unavoidable disturbances such as wildfire, insect outbreaks, or disease make the benefits of permanent reserves more questionable. Recognition of the role of natural disturbance on the Forest necessitates an acceptance that connectivity provided by forest cover will change over time at a small or intermediate scale, and that most species are adapted to such changes, but that rapid succession will maintain connectivity at a large scale.

Connectivity, as coined in 1984 by Merriam (USDA 1997), refers both to the abundance and spatial patterning of habitat and to the ability of animals to move from patch to patch of similar habitat. Structural connectivity is the physical relationship between patches of habitat or other ecological units; functional connectivity is the degree to which landscapes actually facilitate or impede the movement of organisms and processes of ecosystems (Ament et al. 2014). Corridors are a means by which connectivity can be provided. They are strips or stepping stones of “hospitable territory traversing inhospitable territory providing access from one area to another” (USDA 1997). The effectiveness of a corridor depends upon the species using it, the type of movement, and the type of corridor (Hunter 1996). Animals need connectivity to forage within their home range, for dispersal to new home ranges, for migration between locations, and for genetic interaction between meta-populations.

The availability and arrangement of vegetative cover may affect connectivity for some animals. Some species, such as marten, are strongly associated with moderate to high canopy cover (Ruggiero et al. 1994) with forest interior to conditions help them avoid predators, while other species prefer more open or mixed habitats (Tomson 1999b). Characteristics favorable for corridor/linkage zone functionality for most species, especially the large carnivores, include low road density, low concentrations of human occupancy, an abundance of productive foraging habitat, a robust mix of forested and non-forested habitats with abundant edge, and gentle to moderate terrain (Craighead and Vyse 1996; Servheen et al. 2003; Walker and Craighead 1997). In general, a variety of “open habitats” such as montane grasslands, wet meadows, shrublands, early-seral forest, riparian shrub associations, open-grown forest, talus slopes, and burns generously distributed amongst blocks of mature interior forest provide a favorable linkage environment that will accommodate a wider variety of species than unbroken forest alone (Costain 2009).

While there is no empirical evidence to support the concept of corridors (Rosenberg et al. 1997), many conceptual models have been built to project connectivity across landscapes (Noss et al. 1996; Walker and Craighead 1997). For example, the Northern Region Connectivity Protocol (USDA 1997) provides a framework for describing corridors and the effects of forest projects and other human activities. Much of the research suggests that sustaining historic mixes of vegetation in terms of cover types, size classes, patch sizes and arrangement all contribute to sustaining well-distributed wildlife populations and avoiding genetically isolated populations. Much of the research focuses on habitat fragmentation and isolation caused by urbanization and residential development, which are prevalent in the Flathead Valley near Kalispell, but fortunately, are not a problem on large blocks of NFS land, such as the Forest. Rather, barriers to animal movement are more likely to occur on adjacent private, developed lands. According to American Wildlands (2008), maintaining the ecological connections, or wildlife movement corridors, between major wildland habitats is one of the most pressing challenges for habitat and wildlife conservation in the Northern Rockies today.

Many connectivity or corridor studies focused on single species, but in recent years, there has been more emphasis considering connectivity for multiple species at a large landscape scale. In 2007, American Wildlands initiated a "Priority Linkage Assessment" which identified, cataloged and prioritized the threats to, and opportunities for, maintaining connectivity in the U.S. Northern Rockies (appendix 3). The outputs of the assessment included a GIS shapefile that contained polygons of major linkages, species of concern in each, priority of each linkage, and a field that distinguishes which linkages are used for seasonal movement.

ERG modelled connectivity within the American Wildlands polygons, addressing multiple species. Recognizing that connectivity for some species is affected by a lack of habitat components that take a long period of time to restore (Haber and Nelson 2015), connectivity across the Forest was modeled using the query design for marten, because they are one of the species that is more limited by the amount and arrangement of mature tree cover. As a means of assessing long-term habitat connectivity, and as a means of assessing the benefits of permanent reserves, sample landscapes at year 2015 and 2065 were compared by acres of marten habitat, average patch size, and percent habitat occurring in 2015 against the modeled habitat that still remained at 2065. Figure 2 in appendix 3 presents the American Wildlands polygons in the vicinity of the Forest and those selected for this analysis. Polygons were selected for analysis if they contained lands managed by the Forest.

Those polygons represent about 1.16 million acres including NFS, State, and other lands. Additionally, changes in mean patch size were modeled to show how disturbances (fire, insect, disease, or human activities) might affect the size of those patches over time.

Summary of alternative consequences

Within the American Wildlands connectivity areas, National Forest System lands total about 782,000 acres (about 33% of the Forest acres). Mature forest is currently present on about 35% of the connectivity polygons at present and drops to 28% in the fifth decade. The model predicts that all alternatives provide approximately the same levels of habitat in all decades. Levels of mature forest (modelled marten habitat) within the American Wildlands polygons declines by about 75,000 acres out of about 400,000 acres by the end of decade 5, with little difference evident between alternatives. Each alternative is designed to meet desired conditions, but by using different types of stand treatments. Alternative A, for example, has no prescribed burning; alternative B has a mix of regeneration harvest, commercial thinning, and prescribed burning; alternative C places the most emphasis on prescribed burning; while alternative D places the most emphasis on timber production. Because all vegetation management activities are modelled to have a similar end result, it suggests that it is the inevitable and unavoidable disturbances (fire, insect, and disease) that are causing the decline in mature forest habitat within the American Wildlands corridors.

In addition, ERG modelled the number of mature forest patches and the mean patch size within the American Wildlands polygons used to assess connectivity. Mean patch size declines substantially in decades 3 through 5, with a corresponding increase in the number of patches. Declines in patch size, accompanied by an increase in the number of patches, are presumed to have negative effects on interior forest species (e.g. martens, fishers). Mature forest patch sizes in Alternatives B, C, and D show little difference between alternatives by the end of the fifth decade. Alternative A shows slightly less of a decline in mature forest patch size, presumably because Alternative A was modeled without prescribed burning to match the original 1986 forest plan. Most of the area in the American Wildlands polygons is in the wildland urban interface where people live. The wildland-urban interface is where vegetation management would be emphasized and where wildfires would be most aggressively suppressed. Even if fires are suppressed, the model estimates that disease and insect infestations will increase with expected warmer, drier climates. Insects and disease within mixed species forests tend to create numerous small patches.

Larger, more severe stand-replacing fires could result in some very large, even-aged, early-seral patches and reduce the size of mature forest patches, especially in the cool-moist and cold biophysical settings. Modeling suggests that fire coverage and severity, as affected by slope, aspect, and fire suppression, often cumulatively results in a “small patch mosaic”, especially in the warm-dry and warm-moist biophysical settings. Modeling over several decades generally predicts that disturbances tend to reoccur on previously disturbed acres, which further add complexity to existing patterns of forest cover. For instance, severe burns are often followed by re-burns 15-25 years later, after forest debris accumulates on the forest floor. Moderate severity burns are often followed by bark beetle attacks on weakened, surviving trees which may add to the patchiness of forest patterns.

These modeled results suggest that the current mix of patch sizes is likely due to a century-long absence of stand-replacing fire, which has allowed stands to reach large or very large size classes and high densities where the boundaries between them become relatively indiscernible. A return to smaller patch sizes is not only likely inevitable and unavoidable, but perhaps more normal when we consider the effects of natural disturbances.

Environmental consequences alternative A

The 1986 forest plan

Management direction supports key ecosystem characteristics for wildlife connectivity. Management direction specific to connectivity is included in the lynx standards and guidelines ALL 01, ALL S1, ALL

G1, LINK 01, LINK S1, LINK G1, G2; the old growth standards, and riparian habitat conservation area standards.

Environmental consequences alternatives B, C, D

Management direction supports key ecosystem characteristics for wildlife connectivity. Management direction specific to connectivity is included in the lynx standards and guidelines ALL 01, ALL S1, ALL G1, LINK 01, LINK S1, LINK G1, G2; the vegetation standards and guidelines (FW-STD-TE&V-02, 04; FW-GDL-TE&V-06 thru 11; and FW-STD-RMZ-01, 02, 03, 04) and riparian management zone standards (FW-STD-RMZ-01, 02, 03, 04)(figure B-09). This management direction supports key ecosystem characteristics for wildlife connectivity. Alternatives B, C and D include desired condition FW-DC-WL SOI-02 which states that cover conditions in RMZs (see figure B-09) provide shade and contribute to habitat connectivity for a variety of wildlife species that use riparian areas for movement corridors (e.g marten, fisher). In addition, guideline FW-GDL-WL SOI-05 states that "when conducting vegetation management projects, cover of trees and/or tall shrubs should be retained (if available) between areas of forest where cover is lacking (e.g. recent stand-replacement fire areas, clearcut, seedtree, or shelterwood harvest units), so that connectivity between forested patches is not severed (See Appendix C for information on strategies since this will vary on a site specific basis)". Geographic area desired conditions GA-HH-DC-02, GA-MF-DC-06, GA-NF-DC-07, 08; GA-SM-DC-03, 08 (alt. C), and GA-SV-DC-09 also emphasize connectivity in key areas of the valley, as do management area desired conditions for MA6a, b, c-DC-02.

Cumulative consequences

In the Salish Mountains and Swan Valley GAs, many sections (640 acres in size) of forest land managed by one private timber company were regenerated in the last few decades, resulting in a "checkerboard" pattern of cover and non-cover, reducing connectivity for species associated with coniferous forest cover. In the cool-moist and cold biophysical settings of the North Fork Flathead River Geographic Area, NFS lands as well as adjacent lands in Glacier National Park, were regenerated by very large wildfires, also reducing connectivity for species associated with forest cover, but in a pattern of much larger openings. Vegetation modelling has shown that these effects will persist for the next 1-3 decades, but then regrowth of cover would occur and forested connectivity would increase, provided there are not large, new stand replacing wildfires.

As described above, the revised plan includes numerous plan components to support key ecosystem characteristics for wildlife connectivity, but as monitoring of forest conditions in recent decades has shown, extensive stand replacing wildfires, insect infestations, and disease can reduce cover for connectivity across large areas encompassing all lands (see Assessment 2014). Based upon warmer and drier summer climate predicted by most climate models, large stand replacing wildfires are likely to continue to occur in the future and can be expected to affect connectivity of forest cover between Glacier National Park and NFS lands which surround the Park.

The connectivity polygons (identified in appendix 3, figure 2) include all land ownerships. However, even if vegetation management activities on all lands are planned to maintain forest cover, it is not possible to predict exactly where or when wildfires, insect infestations or disease would occur, or if forest succession (that creates cover for connectivity) would outpace loss of cover due to these factors. For these reasons, cover in the connectivity polygons would need to be assessed at the project level at a particular point in time (see appendix C for possible strategies).

Forest-wide desired condition FW-DC-P&C-01 places emphasis on the Forest cooperating with other land managers, including efforts to mitigate threats or stressors, provide for wildlife and fish habitat connectivity, and to promote ecological conditions that contribute to mutual objectives. Where there are willing landowners, the revised plan would also emphasize future connectivity through desired condition FW-DC-LSU-01, which states that land ownership adjustments, through purchase, donation, exchange, or other authority, improve national forest management by consolidating ownership, reducing wildlife-human conflicts, providing for wildlife habitat connectivity, improving public access to public lands, retaining or acquiring key lands for wildlife and fish and within Wild and Scenic River corridors. This would reduce the risk that private lands in key connectivity areas would be commercially developed or subdivided for residences in the future, thus reducing connectivity for wildlife. The Forest's desired conditions complement those of Montana Fish, Wildlife and Parks, as well as those of non-government organizations (such as the Flathead Land Trust, the Nature Conservancy, Stoltze, City of Whitefish) that are working together to maintain connectivity in key areas.

In addition, Ament and others (2014) identified strategies and key locations for highway crossings and four of these are within the Flathead National Forest geographic areas. Because the USFS does not have authority over highways, but does manage some lands adjacent to highways, guideline FW-GDL-IFS-13 states that the USFS should cooperate with highway managers and other landowners to implement crossing designs that contribute to wildlife and public safety in areas identified as key for crossings, based upon Ament and others (see table 33 and figure 37 below).

Table 32. Attributes of priority wildlife mitigation sites based on connectivity value and projected traffic volume (Ament et al 2014).

Segment	Segment Description	Route	Site	Mile Marker	Connectivity Values	Projected Traffic Volume
1	east of Essex	U.S. 2	1a	181-184	black bear and forest generalist corridors, wildlife trails	2,400
1	east of Essex	U.S. 2	1b	189-190	wolverine and forest generalist corridors, forest centrality, wildlife trails	2,400
2	east of Columbia Falls	U.S. 2	2a	141-143	black bear and lynx corridors	8,900
3	north of Columbia Falls	Rt 486	3a	7-9	black bear, lynx, and forest generalist corridors	800
4	between Whitefish and Eureka	U.S. 93	4a	148	grizzly linkage zone, forest centrality	3,800
4	between Whitefish and Eureka	U.S. 93	4b	157-160	grizzly linkage zone, black bear and forest generalist corridors	3,700

In summary, the cumulative consequences of plan components on the Forest, in the context of all lands of the larger landscape, contribute to the ecological integrity of habitats that support marten. This would be accomplished by plan components promote retention of old growth habitat, very large live, decayed and dead trees, and forest resilience. While the Forest does not have authority over all stressors that may affect marten, the Forest contributes to the ecological conditons that support them. Plan components also help to provide cover for connectivity in riparian areas and other key areas of the forest where available (e.g. if not burned by recent wildfire), limit road access, and promote cooperation with other agencies on activities such as highway crossings and conservation easements that benefit numerous species. While the USFS cannot control all stressors that affect connectivity, NFS lands would help to promote connectivity of habitats with CSKT tribal lands, Glacier National Park, Canada, and adjacent forests.

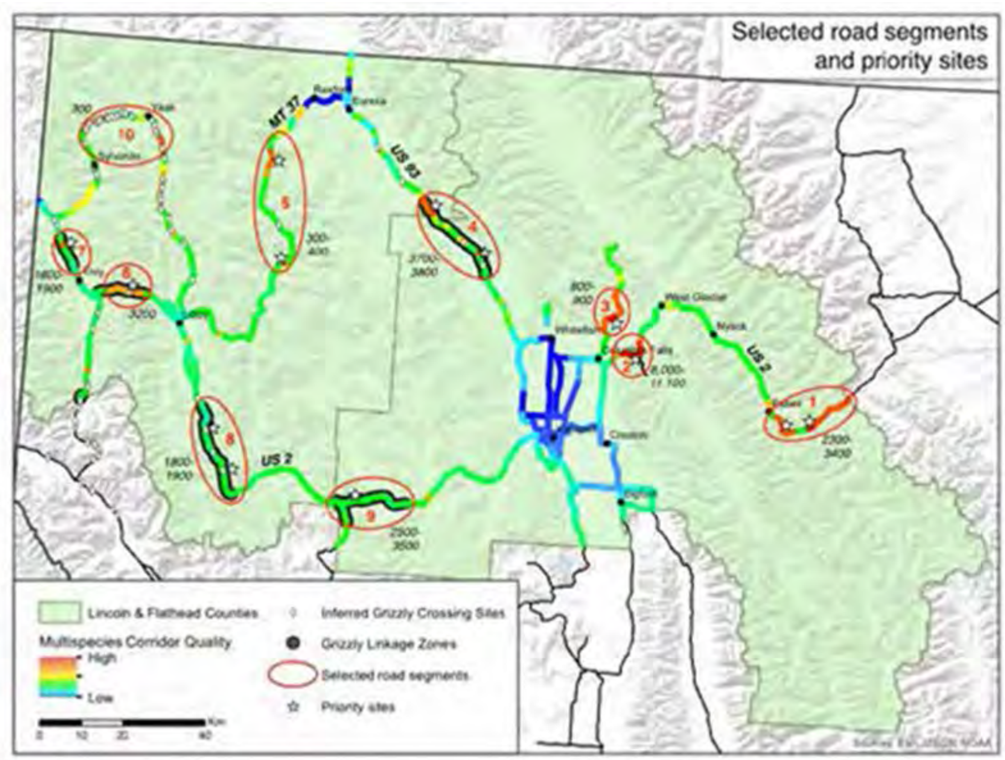


Figure 37. Wildlife highway crossings location and quality on selected road segments and priority sites in Lincoln and Flathead Counties (Ament et al 2014)

Wildlife associated with old growth habitat and very large live and dead trees

Key indicators for analysis for most wildlife species associated with old-growth habitat and very large live and dead trees

In addition to key indicators addressed in the Vegetation sections 3.3.5, 3.3.7, 3.3.8 and 3.3.10 and "coniferous forests in a variety of successional stages", the following indicators are important for the wide variety of wildlife species associated with old growth habitats and very large live and dead trees. The indicators were developed after considering key stressors, public comments, and issues identified during scoping.

- Plan components to support key ecosystem characteristics for species associated with old growth forest, the very large tree size class, and the distribution of very large live trees, very large snags, and large down woody material in other forest size classes.

Introduction

There are about 30 wildlife species on the Forest associated with old growth or its key characteristics (see appendix D, planning record exhibit V-12). The Forest has adopted the definitions of old growth forest developed by the Regional Old Growth Task Force and documented in Green et al. 1992 (as corrected by errata in December of 2011). The definitions are specific to forest type (dominant tree species) and habitat type group. Key attributes for identification of old growth forest are age, numbers and diameter of the old tree component within the stand, and the overall stand density. Minimum thresholds have been established for these attributes and provide measurable criteria for implementation of standards related to old growth forest stands. For example, the most common old growth forest type on the Forest requires at least ten trees per acre that are at least 180 years in age and 21 inches in diameter, with a minimum stand density of 80 square feet basal area (see Vegetation section of Chapter 3 for more details).

In addition to the measurable criteria established by Green et al., there are associated forest structural conditions that provide key ecosystem characteristics for wildlife species (e.g. very large decayed trees, very large snags, and large fallen trees). Species associated with old growth habitat use these key ecosystem characteristics in a variety of ways, including nesting, roosting, denning, feeding, and shelter. For example, several small mammal, amphibian, and invertebrate species use accumulations of large down woody material, debris and duff on the forest floor for shelter (Carey 1996). Variation in live tree size and spacing in old growth habitat also provides canopy gaps and understory patchiness (Helms 1998). Patches of open canopy within or adjacent to old growth habitat provides foraging opportunities for some species. Birds that nest in very large snags prefer various tree species, minimum diameters, minimum snag heights, states, and types of snag decay (Thomas and others 1979) (Smith 1995). The minimum diameter and density of very large snags used for plan components in the no action alternative came from a comprehensive publication on managed forests in the Blue Mountains of Oregon and Washington (Thomas 1979) (USDA FS 1999, Forest Plan Amendment 21). Thomas based desired snag densities on territory size for primary excavators (woodpeckers) and the number of pairs per hundred acres, because these birds are territorial. Bate (1995) studied the effects of forest vegetation characteristics on woodpeckers in the warm-dry forests of central Oregon. She found that woodpecker density increased as the density of large live trees greater than 20” d.b.h. and hard snags greater than 10” d.b.h. increased (excluding lodgepole pine), but she was not able to detect a threshold where woodpecker abundance dramatically changed. As a result, she did not recommend a minimum number of live trees or snags per acre to support woodpeckers. While minimum snag diameters are known for many species, there may be a high level of uncertainty with respect to minimum snag densities.

The study by Thomas and others listed the following wildlife species known to occur on the Flathead National Forest as requiring snags [and also broken-topped live trees] with a minimum d.b.h of 20 inches for nesting or denning; pileated woodpecker, wood duck, common and Barrow’s goldeneye, common merganser, barred owl, Vaux’s swift, and fisher. With the exception of the pileated woodpecker, minimum tree diameters required by these species have not been listed based upon research in Montana. Of the species requiring trees greater than 20 inches d.b.h., only one, the pileated woodpecker, is a primary excavator. Primary excavators hollow out nest and roost sites for themselves which are then used by close to 60 other species on the Forest, some of which are incapable of excavating their own cavity. For example, flying squirrels and fishers are known to use cavities excavated by pileated woodpeckers. Brown creepers are known to nest beneath the bark of decaying live trees or in cavities made by pileated woodpeckers or northern flickers. Brown creepers nest within mature spruce/fir forests with multilayered canopies and a highly complex structure, including a mosaic of openings or meadows (Hayward and Hayward. 1993. *IN* the Birds of North America online).

The availability of old growth habitat and very large trees varies greatly over time and across the landscape. Unlike some of the northwest coast forests, in the northern Rocky Mountains there is very little coniferous forest that goes for hundreds of years without wildfire (see Vegetation section of Chapter 3 for more details). Some tree species in the northern Rocky Mountains have adaptions to survive in areas burned with stand replacing wildfire. As a result, many of the northern Rocky Mountain wildlife species associated with old growth habitat are also associated with components of old growth habitat (very large live, decayed, dead, and down trees) occurring in forest stands that have a predominantly younger age class (also see Old Growth and Size Class sections; Vegetation section of DEIS Chapter 3 for more details).

Very large trees have wildlife value even when the surrounding area has been burned or logged (Henjum 1996) and can serve as reservoirs of genetic diversity. Very large remnant trees enrich the subsequent forest stand structure by providing a source of large snags and coarse woody debris and improving the connectivity of the forest landscape for many wildlife species. In western forests where fire is a dominant disturbance process, maintaining a large and very large-diameter cohort of trees in perpetuity may be an appropriate method to achieve objectives for wildlife and fire resiliency (Habeck 1990, Franklin and others 1997).

Old growth wildlife habitat has been defined by some as old growth forest, by some as late successional forest, and by others as the very large tree size class (see Vegetation sections of DEIS Chapter 3 for more details). Standards for old growth forest are based upon measurable criteria and are monitored using FIA data. FIA field procedures collect tree d.b.h. and measure age, so these criteria can be used to for a statistically sound estimate of the amount of old growth across the forest (refer to Vegetation Information Sources section).

Affected environment

The summary of old growth forest acres on the Forest as derived from FIA inventory data is about 9.0% of the total forest acres. Old growth forest totals about 3.9% of the warm-moist biophysical setting, 10.6% of the warm-dry, 8.8% of the cool-moist to moderately dry, and 10.5% of the cold biophysical. A large amount of area has burned across Forest lands over the past 15 years (refer to Fire and Fuels section). These fires are primarily responsible for the loss of an estimated 2.9% old growth (approximately 57,000 acres) over that time period (source: R1 Summary database, comparison Hybrid 2011 dataset with previous version, Hybrid 2007). No old growth on the Forest has been removed through harvest treatments for at least 15 years (the current forest plan prohibits removal of old growth through harvesting). Because FIA data is not a spatial dataset, patch sizes and connectivity of old growth is unknown at the Forest scale, but is analyzed at the project level.

In addition to forests that meet measurable Green et al. criteria for old growth, very large trees (>=20 inches d.b.h.) are present in forest stands that do not meet all of the old growth criteria. These are generally the more fire tolerant species such as western larch, ponderosa pine and Douglas-fir. They are often present in stands with a smaller average size class, because the stand as a whole has burned and regenerated, but these very large fire-tolerant trees have survived. These very large trees can contribute to future old growth and are valuable for wildlife species whether they occur at low densities or high densities and whether they are live, dead (snags), or down woody material. Table 34 displays the current mean percentage of NFS lands with very large trees within all size classes in each biophysical setting (90% confidence interval). There is a larger percentage of the forest with these very large trees than there is in old growth forest or the very large size class (see Vegetation section for more details).

Table 33. Very large tree subclass definitions and current estimated percent, forestwide and by biophysical settings

Biophysical setting	Very large tree subclass tree density criteria	Current estimated percent of NFS lands
Forestwide	Incorporates the criteria specific to each biophysical setting	14.1 (11.9-16.5)
Warm Dry	At least 8 trees per acre greater than or equal to 20 in. d.b.h.	18.9 (11.6-27)
Warm Moist	At least 10 trees per acre greater than or equal to 20 in. d.b.h.	11.5 (2.5-22)
Cool Moist-Mod Dry	At least 10 trees per acre greater than or equal to 20 in. d.b.h.	14.5 (11.8-17.4)
Cold	At least 10 trees per acre greater than or equal to 15 in. d.b.h.	9.2 (4.0-15.2)

Forests with very large trees are also more likely to have very large snags. Table 35 displays an estimate of the current density of snags greater than 20 inches d.b.h. at a broad scale across the Forest. Additional tables displaying estimates across smaller analysis units composed of groupings of vegetation dominance types and potential vegetation types can be found in the Assessment of the Flathead National Forest (2014).

Table 34. Current snag densities on the Forest inside and outside wilderness/roadless areas.

Analysis Unit	Snags per acre equal to or greater than 20 in. d.b.h.		
	Mean	**Lower bound**	**Upper bound**
Outside Wilderness	1.1	0.7	1.6
Inside Wilderness	0.9	0.6	1.1

Two of the species associated with old growth habitat and very large live and dead trees are specifically addressed as examples in this section in order to help display differences in effects of alternatives, but effects to other species associated with these key ecosystem characteristics may be similar. The fisher is a species of conservation concern and the pileated woodpecker is analyzed because it is a primary excavator that makes cavities used by many other wildlife species. In addition to coarse filter plan components, there may be species-specific plan components to address species needs. For detailed information on the population and life history of these species refer to the Montana Field Guide (http://fieldguide.mt.gov) and the Montana Partners in Flight Bird Conservation Plan (Casey 2000) (See Appendix D of Revised Forest Plan for a full list of species).

The affected environment section above describes key ecosystem characteristics. The key stressors section which follows provides a foundation for the alternative effects analysis and an understanding of which stressors the USFS has authority to manage. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are activities that might impact a species and its habitat if not managed or mitigated. Stressors that are outside of Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. These are considered under “cumulative consequences”.

Key stressors under USFS control

Land management: The primary stressors are loss and fragmentation of old growth habitat. Timber harvest, road construction, firewood gathering, wildfire, prescribed fire, and insects or disease can affect old growth habitat, very large live and dead trees, and associated species.

Key stressors not under USFS control

Climate change: Both drought and wildfire have historically been stressors, but their magnitude and duration are anticipated to increase by the 2040’s based upon modelled climate changes (see section of Chapter 3 on relationship of revised forest plan and future climate for more details). Drought may also lead to an increase in insects and/or disease.

Response to anticipated changes in climate will vary by tree species and structure, so response by associated wildlife species also varies. The most important tree species for a variety of wildlife species associated with old growth habitats on the Forest are western larch, ponderosa pine, and black cottonwood, because these species are key for primary cavity excavators that make nesting and denning cavities required by many other wildlife species. Large Douglas-fir provide important feeding habitat and also provide cavity nesting and denning habitat for a variety of wildlife species, but snags do not persist as long as western larch or ponderosa pine (see Vegetation section of Chapter 3 for more details).

Summary of alternative consequences

All alternatives include a standard to maintain all existing old growth forest (meeting Green et al. definitions) and set limitations on vegetation treatments within old growth (see Vegetation section of DEIS Chapter 3 for more details). This standard has been in effect since 1999, but old growth forest has continued to decline by 2-3% across the Forest, primarily due to the effects of wildfire. This trend is expected to continue with projected future climate and associated levels of stand replacing wildfire, insects, and disease. As a result, the action alternatives include additional plan components to increase the very large tree size class, retain very large live trees and snags in forest stands of smaller size classes, and to retain larger snags and down woody material in harvest units, as described below.

The very large tree size class trends steadily downward over the five decade modeling period under all alternatives, forestwide and in all biophysical settings except the warm dry and warm moist biophysical settings. In most cases, it decreases to a level that is at or just below the minimum desired range. Much of this decrease is likely attributable to wildfire and/or the high amount of both Douglas-fir and spruce beetle portrayed in the model, both of which would cause widespread mortality of trees in the very large size classes and revert forests back to a smaller size class (refer to Vegetation section 3.3.5 and 3.3.10 and appendix 2). As modeled, the warm dry biophysical setting shows a distinctly different trend in the very large size class when compared to other settings. Vegetation management treatments (particularly prescribed fire) likely plays a major role in promoting the development of the very large tree size class, as it removes the smaller diameter understory trees (mainly Douglas-fir) and preserves larger diameter overstory trees (mainly ponderosa pine). Commercial thinning may also be influencing this increase in very large size class as well.

Fire suppression is likely to be most successful in the valley bottoms where people live (primarily the warm-dry and warm-moist biophysical settings), resulting in better retention of the very large tree size class and very large trees within younger age classes. In the wildland-urban interface, precommercial thinning, timber harvest, and prescribed burning would reduce stand densities, increase very large tree survival, and increase the rate at which very large trees develop. Outside the wildland-urban interface, particularly in the cool-moist or cold biophysical settings, vegetation management standards promote development of forests in the large and vary large size classes containing spruce and subalpine fir in multi-storied stands with a dense understory. These forests would be more susceptible to wildfire and have higher levels of mortality due to insects and disease (especially for Douglas-fir and Spruce). The trend for loss of old growth forest and the very large size class due to wildfire is likely to continue in these forest types in the future.

When very large live trees are killed, the number of very large dead trees (snags and down woody material) would go up. This would be beneficial to wildlife species that depend upon very large snags and down woody material, provided that reductions in canopy cover created by loss of live trees do not become limiting (see individual species sections below). Trends in very large snag numbers increase over the five decades under all alternatives. The increase in very large snags (20+ in. dbh.), especially in the "4+ snag per acre" density category corresponds to the decrease in the very large live tree component. These snags would provide abundant downed woody material over time. Desired conditions for snags and downed wood are expected to be met forestwide under all alternatives in the future.

The Spectrum model (used for modelling alternative vegetation treatments) does not model salvage harvest of dead trees, but it is likely that salvage harvest would occur. In addition to suitable lands discussed under the section on coniferous forest in a variety of successional stages, timber harvest is allowed on lands not suitable for timber production, for such purposes as salvage, fuels management, insect and disease mitigation, protection or enhancement of wildlife habitat, to perform research or administrative studies, or recreation and scenic-resource management. Timber harvest on these lands would have to be consistent with other management direction. Timber harvest on these lands is not scheduled or managed on a rotation basis, but they do contribute towards projected sale quantities.

Acres where timber harvest is allowed on land not suitable for timber production are as follows: alternative A, 19 percent of the Forest; alternative B, 17 percent of the Forest; alternative C, 16 percent of the Forest; and alternative D, 21 percent of the Forest (see figures 1-07 to 1-10, timber suitability by alternative). Under alternatives B and D, approximately one-half of these acres are comprised of inventoried roadless areas (figure B-02). For alternative C, the largest percentage of these acres are those allocated to MA 6a. Salvage harvest within stands that were previously old growth is likely to be about the same for alternatives B, C, and D because they emphasize creation of future old growth and retention of very large snags to the same degree. FW-GDL-TIMB-04 specifies that when salvaging timber in areas that previously met Green et al. definitions of old growth forest, standing live, dying and dead western larch, ponderosa pine, and black cottonwood trees greater than 20 inches d.b.h should be retained to contribute to future forest structure for wildlife.

Environmental consequences alternative A

A key difference of this alternative when compared to the action alternatives is related to the forest plan direction associated with both forest size classes and the very large tree component. The 1986 Plan does not explicitly describe desired conditions for forest size classes and very little if any specific direction related to forest size classes or to very large tree components. It does incorporate an ecologically-based approach to management of vegetation, including managing for vegetation composition, structures and patterns that would be expected to occur under natural succession and disturbance regimes; reducing the risk of undesirable fire, insect and pathogen disturbances; and providing for long-term recruitment of forest structural elements such as snags and downed wood. Most of this direction is located in the forest-wide objectives under section A(6)-Vegetation (pg. II-8, 1986 Forest Plan) and forest-wide standards under (H)-Vegetation (pg. II-47, 1986 Forest Plan).

Amendment 21 (A21) of the 1986 Forest plan provides direction to: 1) protect all existing old growth, as defined by Greene et al.; 2) retain an average of 1 snag per acre greater than 20 inches dbh in the dry potential vegetation group and an average of 1 snags per acre greater than 20 inches dbh in the dry and cold potential vegetation groups and an average of 2 snags per acre of this size in the cool potential vegetation group, 3) retain an average of 10 pieces of down woody material greater than 20 inches diameter in harvest unit in the dry potential vegetation groups and 15 pieces of this size in the cool and cold potential vegetation groups; and 4) provide habitat connectivity and patch sizes on National Forest system lands similar to that experienced historically (see Vegetation section of Chapter 3 for more details). This management direction provides benefits to species associated with old growth, very large snags, and down woody material.

Environmental consequences alternatives B, C, D

The action alternatives benefit wildlife because plan components place more emphasis on retaining very large trees outside of stands that meet the definition of old growth forest compared to alternative A. This would benefit wildlife because old growth forest is likely to continue to be reduced due to wildfire, so maintaining forests in the very large size class that do not meet the Green et al. definitions, as well as maintaining key ecosystem characteristics, such as very large live, decayed, and dead trees in younger stands, is key for many animals.

All action alternatives have desired conditions FW-DC-TE&V-11, 12, 13, 15, 16, 17 and 18, which address benefits to wildlife associated with old growth forest, the very large tree size class, and very large live and dead trees. The desired condition is to maintain or increase the area and/or density of the very large live tree component. The desired species of very large trees are western larch and ponderosa pine in the warm dry and warm moist biophysical settings, with the addition of western white pine and western red cedar in the warm moist setting. For all forest size classes, there is an expectation that there will be wide fluctuation over the short and long term, because of the complex inter-relationships between ecological processes (such as succession) and disturbances (such as fire), and the influence of other resource desired conditions and objectives.

Management standard FW-STD-TE&V 02 states that in in old growth forest, vegetation management activities must not modify the characteristics of the stand to the extent that the stand would no longer meet the definition for old growth (refer to glossary). Vegetation management within old growth shall be limited to actions that:

- Maintain or restore old growth characteristics and ecosystem processes;
- Increase old growth forest resilience to disturbances or stressors that may have negative impacts on old growth characteristics (such as drought, high severity fire, bark beetle epidemics);
- Reduce fuel hazards adjacent to private property or other exceptional values at risk; or
- Address human safety.

Vegetation management activities that may be used to meet these requirements include (but are not limited to) planned or unplanned low to mixed severity fire; removal of hazard trees in developed campgrounds; commercial or non-commercial thinning to reduce tree density; or treating insect and disease infestations through integrated pest management strategies.

All action alternatives include standard FW-STD-TE&V 04 which states that in the absence of a site-specific analysis that supports an alternative prescription for snags or decadent live trees, timber harvest areas shall retain at least 1 snag per acre greater than 20 inches dbh in the cold potential vegetation group, 1.4 in the warm-dry, and 2.0 in the warm-moist, and cool-moist potential vegetation groups. This standard also states, "All western larch, ponderosa pine, and black cottonwood snags greater than 20 inches shall be left. If present, decadent live trees greater than 20 inches dbh., especially those with evidence of wildlife use, may be used as a substitute for 20 inch dbh. snags, to achieve minimum levels. Exceptions to this snag retention standard may occur, for example in areas where the minimum number or snags or decadent live trees are not present prior to management activities; where there are issues of human safety (i.e., developed recreation sites); and in areas within 200 feet of a road that is open to firewood cutters. Refer to Appendix C for guidance on implementing this snag retention guideline".

Cumulative consequences to most species associated with old growth habitat, very large live and dead trees

This section summarizes activities and effects that are common to most species associate with old growth habitat, very large live and dead tree habitats. Also see the individual cumulative consequences s sections for specific species.

Past management actions, particularly timber harvest and fire suppression, have altered stand structure, composition, function, and connectivity, particularly in valley-bottom areas that historically had low and moderate severity fire regimes and are now in the wildland urban interface (wildland-urban interface). In these areas, a century of fire exclusion, coupled with extensive logging, has changed historically open forests into more closed, dense forests that are often dominated by Douglas-fir.

Past timber harvest on National Forest System lands as well as state and private lands managed for timber harvest decreased the availability of very large live trees, snags, and down logs (see Vegetation section for more details). Prior to the 1986 forest plan, contract utilization standards required many dead trees to be removed in harvest units, resulting in a lack of snags and down wood in harvest units. Timber harvest prescriptions and timber sale contracts now include direction to retain snags in harvest units and also require retention of large down wood.

Within the boundaries of the Forest, there are three state forests, as well as scattered parcels, managed by Montana Department of Natural Resources and Conservation (DNRC). DNRC manages old growth according to the Administrative Rules of Montana for forest management (36.11.418 biodiversity - old growth management), which directs the department to manage old growth to meet biodiversity and fiduciary objectives. The department considers the role of all stand age classes, consistent with the range of natural disturbances, when designing harvests and other activities to maintain biodiversity. Old growth was constrained in DNRC's 2015 sustainable yield calculation such that 8% of forest stands on lands managed by their Northwestern and Southwestern land offices are to meet the minimum quantifiable definitions of old growth by Green et al. 1992 (and as amended). The project level considerations of DNRC complement those of the Forest with respect to maintenance of old growth habitat, very large live and dead trees to support wildlife.

An increase in private residences or an increase in people who burn firewood can result in loss of very large snags on all lands, particularly the largest, most desirable wildlife snags such as "buckskin larch," which may have sound wood in the lower bole but decayed tops. This effect is most likely to occur within 200 feet of open roads. Past road building on federal, state and private lands likely impacted the distribution of snags, but road influences have decreased over time. Access management has resulted in fewer routes open to motor vehicle use on federal, state, and private lands, helping to protect very large snags from removal for firewood.

In the future, increases in insects/disease are likely to affect all lands if the climate becomes warmer and drier. Bark beetle activity removes the larger diameter trees-- mainly Engelmann spruce and Douglas-fir, as well as lodgepole pine of medium and larger size classes. Douglas-fir and Ponderosa pine tolerate drought better than nearly all other species and so may be favored by expected changes in climate, while western larch is a species that is highly susceptible to climate warming. Western larch and Ponderosa pine have the ability to survive fire provided they can get large enough between fires and fuel-loading is not too great)(NRAP 2015). Most climate change studies predict major losses of live western larch throughout the Northern Rockies, which could create an abundance of habitat for cavity-nesting species, but would also reduce canopy cover and recruitment of western larch. On state and private timber lands, many dead trees are likely to be salvaged.

If the size, severity, and/or frequency of wildfires increases in the future due to climate change it could cause widespread declines in the availability of late successional or old growth habitats, because it can take 100 years or more for trees to reach diameters of 20 inches. If species that are adapted to surviving wildfire (such as western larch, ponderosa pine, and Douglas-fir) reach large enough size between wildfires, wildlife habitat will be retained. However, if they do not grow large enough between wildfires, forest dominance types could be changed to species such as lodgepole pine, which rarely reaches diameters of 20 inches dbh and which is easily killed by fire, but able to regenerate from seed earlier than other species.

In all alternatives, our direct ability to affect future amount of old growth forest is very limited. Fire and other natural disturbances will continue to influence this landscape substantially more than vegetation treatments, and succession will continue to be the primary means by which old growth forest is formed. Vegetation treatment promoting development of old growth over the long term (such as commercial and non-commercial thinning in young stands) are available as management tools over a small portions of the Forest (see table 12 and table 13). Old growth amounts and distribution will remain highly dynamic and variable over time, as it has been historically.

In summary, the cumulative consequences of plan components on the Forest, in the context of all lands of the larger landscape, contributes to old growth wildlife habitat. This would be accomplished by plan components to maintain all existing old growth, retain very large live, decayed and dead trees in harvest units for the long-term, and promote development of very large trees. While the USFS cannot control all stressors that affect old growth wildlife habitat, would help to provide old growth habitat within the ecological capacity of NFS lands. In addition to effects on most species associated with old growth habitat and very large live and dead trees, the following sections describe species-specific effects.

Fisher (SCC)

Key indicators for analysis

In addition to the plan components, indicators, and effects described in the Vegetation sections 3.3.5, 3.3.7, 3.3.8 and 3.3.10 and "coniferous forests in a variety of successional stages", "old growth habitat, very large live and dead trees >20" dbh," and "coniferous forest; and snags less than 20" dbh" described above, the following indicator applies:

- Plan components to support key ecosystem characteristics for the fisher

Affected environment

Population, life history, habitat, and distribution: The fisher has been listed as a species of conservation concern for the Forest by the regional forester (see www.fs.usda.gov/goto/flathead/SCC). Fisher are distributed across portions of Canada, the Rocky Mountains, the Cascade Mountains, the Great Lakes region, and portions of the Pacific coast region. Fishers are patchily distributed in the Northern Rockies. They are found almost exclusively in the inland maritime ecosystem in Idaho, and in areas where it extends eastward into western Montana (NRAP 2015). The historical distribution of fisher and fisher habitat in Montana is uncertain, but Weckwerth and Wright (1968) reported that the fisher once occurred in western Montana, with a few animals trapped in what is now Glacier National Park prior to 1911. Due to a lack of trapping records in Montana from 1929-1959, many biologists believed the fisher had been extirpated (Vinkey 2003). Trapping, as well as large regional fire events in 1910 and 1934, likely contributed to regional fisher population declines in the early 1900's (Jones 1991).

In five separate reintroduction efforts, fishers were translocated from Minnesota and British Columbia to the northern Rocky Mountains between 1959 and 1991 (Weckwerth and Wright 1968, Vinkey et. al 2006). Translocations placed 78 British Columbia fishers into western Montana and Idaho between 1959 and 1963 and another 110 fishers from Minnesota and Wisconsin into the Cabinet Range in northwestern Montana between 1989 and 1991. Vinkey and others (2006) stated, "We believe it likely that fishers from northwestern Montana are descended from both the 1959 and 1989–1991 reintroductions". One of the relocations was near Holland Lake on the Flathead National Forest, where 15 fisher were released in 1959 and 1960. Eleven of these fisher were subsequently "re-captured"; eight were killed by trapping, one was shot, one was found dead, and one was released alive. Four fisher that were released on the Kootenai National Forest (adjacent to the Forest), dispersed to the Forest and were later re-trapped and released (Weckwerth and Wright 1968). Subsequent to reintroductions, 18 fisher were trapped on or within 1 mile of the Forest boundary from 1985-2002, according to MNHP records. Most of the trapped animals were listed as animals transplanted in 1959 or 1960, or were animals believed to be their offspring (MNHP 2013). The MNHP data base includes additional observations of fisher through 2008, but these observations have not been verified with trapped animals or DNA. In the Cabinet Mountains of the

Kootenai National Forest, at least 9 of 32 fishers transplanted from Wisconsin were known to have been killed by other predators (Roy 1991 *IN* Ruggiero et al. 1994). It is possible that the differences between Wisconsin and Montana in habitat, topography, prey, and predators somehow made these fishers vulnerable to predation (Ruggiero et al. 1994). Information is lacking on the survival rates and reproductive success of fisher in the Northern Rockies (Sauder 2014).

Non-invasive survey efforts have occurred from 2006-2014 over portions of the Forest and adjacent Glacier National Park. The Southwest Crown of the Continent carnivore project conducted snow track surveys and used DNA collection methods (hair snares and bait stations) developed by researchers with the USFS Rocky Mountain Research Station. A 5 by 5 mile grid was overlaid on the entire SW Crown landscape (including the southern portion of the Forest) and these grid cells were systematically surveyed. Across all three years (2012-2014), 82 of the 129 grid cells were surveyed and no fisher were detected (Southwestern Crown Carnivore Monitoring Team 2014). However, grid cells in the remote Bob Marshall, Great Bear, and Scapegoat wilderness areas have not been surveyed, so it is unknown whether fisher may occur there. Surveys in Glacier National Park and on the rest of the Forest have also been unsuccessful in detecting fisher (unpublished data; pers. comm. J. Waller, Glacier National Park Supervisory Wildlife Biologist; K. Pilgrim, USFS Rocky Mountain Research Station 2016). Even when fisher are known to be present in an area, they occur at extremely low densities and are very difficult to detect.

Vinkey (2003) reviewed historical records as well as carnivore research in Montana and concluded that the fisher is one of the lowest-density carnivores in the state. In high-quality habitats in British Columbia, fisher densities were between 0.03 and 0.04 per square mile or approximately 1 per 21,000 acres (USFWS 2010). Interactions with other species in diverse ecosystems (e.g., mountain lions, wolves, coyotes, wolverines, and lynx) may affect fisher distribution, competition for prey, or these species may prey upon fisher (Fisher et al. 2011). Fishers also appear to be restricted to areas with relatively low snow accumulation (Jones 1991). Deep, fluffy snow (which occurs on much of the Forest) affects habitat use by fishers (Raine 1983 *IN* Ruggiero et al. 1994) and may affect distribution, population expansion, and colonization of unoccupied habitat (Arthur et al. 1989b; Aubry and Houston 1992; Heinemeyer 1993; Krohn et al. 1994 *IN* Ruggiero et al. 1994). Powell and Zielinski stated that if trapping seasons are regulated carefully in Montana to prevent over-trapping, fisher populations may slowly expand, but if fisher populations are limited by deep snow, fishers may never reach high densities (Powell and Zielinski *IN* Ruggiero et al. 1994).

Currently, eight national forests have some of their lands within the expected range of fisher in the USFS Northern Region (Cushman et al. 2008, Schwartz 2007, Olson et. al 2014, Schwartz et al. 2013, Sauder and Rachlow 2014, Sauder 2014). Olson and others (2014) stated that fishers were more likely to occur in areas with wetter, milder climates characterized by higher mean annual precipitation, mid-range winter temperatures, and topography in the form of drainages or valleys. Raine (1983) found that movements of fisher were restricted by the soft, thick snow cover that was present during midwinter, whereas marten did not appear to be hindered by soft snow cover to the degree that fisher were. On the Forest, snow conditions may be a factor in limiting fisher populations and their distribution.

The importance of riparian areas for the presence of fishers has been shown in studies conducted in British Columbia, the southern Sierra Nevada in California, and northwestern Montana (Zielinski et al., 2004). On the Forest, most of the habitat modelled by Olson and others (2014) occurs as riparian stringers rather than large patches.

The Northern Rocky Mountain region has a history of periodic regional wildfires and habitat in the Northern Rockies is likely sub-optimal (Lofroth et al. 2010, Schwartz et al. 2013). A period of fewer fires occurred from the 1940’s to1980’s, at the same time that fisher were being re-introduced in parts of Idaho and Montana and more fisher were detected during this time period. Since the late 1980s, the Northern Rockies has experienced more frequent fires (Westerling et al. 2006). Stand-replacing wildfires have increased substantially on the Forest since 1988 (see Fire section of DEIS Chapter 3).

Sauder and Rachlow (2014) described fisher habitat selection at the landscape scale, which they defined as an area from 12,355-24,710 acres in size. These authors characterized fisher habitat as a variety of habitat patches to support prey species within a matrix of mature forest arranged in connected, complex shapes and with few isolated patches (Sauder and Rachlow 2014). These authors found that the percentage of mature forest was not the best supported variable for predicting fisher occupancy, nor was the percentage of high canopy cover.

Schwartz and others (2013) reported on habitat characteristics at multiple, nested scales. They described the landscape scale as features within a 0.62 mile radius surrounding known fisher locations. At a landscape scale, they found that fisher use was highest where large trees (greater than about 15 inches dbh) made up about 50% of the landscape, but began to decline when the proportion was higher. These results are similar to Jones and Garton (1994) who found fishers selecting mature and old growth forests during the summer, but using a wider array of habitats in winter (Jones and Garton, 1994). In the Rocky Mountains, there are times of the year where young to medium-age conifer forests are preferred (Jones 1991; Roy 1991), but fishers avoid large open areas with very low canopy closure, an aversion that may limit population expansion (Ruggerio et al. 1994). Riparian corridors have been identified as being important for connectivity (Jones 1991), but the minimum width is unknown.

As summarized by the USFWS, “Though capable of long- distance movements, fisher generally have small dispersal distances. Small dispersal distances may be a factor of fishers’ reluctance to move through areas with no cover (Buskirk and Powell 1994, p. 286). Thus, where habitat is fragmented it is more difficult to locate and occupy distant yet suitable habitat, and fishers may be aggregated into smaller interrelated groups on the landscape (Carroll et al. 2001, p. 974)”. (USFWS 2011).

At a stand scale, Schwartz and others (2013) suggested that mature forest stands most used by fisher are have both large and smaller trees, consistent with evidence that fishers need cover for hunting efficiency or predator escape purposes. Schwartz and others (2013) found that locations used by fisher at the stand scale were closely correlated with the maximum dbh of trees. There is no known threshold for minimum number and size of trees needed by fisher, but they are known to use the largest trees available. Fisher selected for stands containing western red cedar and grand fir, while they avoided ponderosa pine and lodgepole pine stands (Schwartz et al. 2013). On the Forest, western red cedar and most grand-fir habitat types are included in the warm-moist biophysical setting and are at suitable elevations for use by fisher.

Schwartz and others (2013) stated that managers can maintain fisher resting habitat by retaining large trees and using forest management practices that aid in the recruitment of trees that achieve the largest sizes. They also recommend increasing structural diversity at these sites. Components of structural diveristy needed by fisher include very large trees, snags, fallen logs and stumps as well as seedlings, shrubs, and herbaceous cover (Meyer 2007) (Ruggiero et al. 1994). Timber harvest and wildfire can temporarily remove habitat elements that are essential for fishers (Hann et al. 1997, Franklin et al. 2002a, Green et al. 2008, Wisdom and Bate 2008).

Snowshoe hares are the most common prey for fishers. For fishers in the Cabinet Mountains of Montana, 50% of the prey remains found in 80 scats were from snowshoe hares. Mice and other small rodents constituted the next most common prey (Roy 1991 *IN* Ruggiero et al. 1994).

Key stressors under USFS control

Land management: Fisher habitat quantity and quality on NFS lands can be reduced by fragmentation of old growth or late-successional forest if it isolates habitat patches or if it reduces structural diversity including very large live trees, snags and down logs. This can occur due to extensive stand-replacing wildfires, timber harvest, or firewood cutting in the grand-fir, cedar, hemlock portions of the warm-moist and in riparian portions of the cool-moist biophysical setting.

Key stressors not under USFS control

Climate change: Some climate models project that the lower elevations of northwest Montana will have less snowfall in the future, with more precipitation falling as rain. This could be beneficial to fisher, but downscaled model projections for winter precipitation are still highly uncertain. Over the long-term, according to the preliminary Northern Region Adaptation Partnership risk assessment for fisher (NRAP 2015), "Fishers are found in the relatively warm and wet conditions associated with the inland maritime ecosystem. Fisher habitat quality is projected to decline in virtually all areas where fishers currently exist, coupled with increased habitat quality in areas to the east and south. However, the old forest structures that fishers are currently associated with require significant time to form; it is unknown whether similar climate will equate to similar habitats in the short term".

Management of private lands: Habitat connectivity across private lands may be negatively affected by clearing of land for homes and other developments or regeneration timber harvest that isolates habitat patches. Structural diversity including very large live trees, snags and down logs may also be reduced.

Trapping: Trapping may affect the distribution and abundance of fisher. Following re-introduction, many fisher were trapped on the Forest during the 1980's and then trapping limits were reduced. In Montana, the species is legally trapped under a limited quota system, allowing for take of two individuals in trapping district 1, located in northwestern Montana (http://fwp.mt.gov/hunting/planahunt/huntingGuides/furbearer/).

Summary of alternative consequences

All alternatives have plan components that would support key ecosystem characteristics for the fisher, because all existing old growth would be retained and would provide the very large snags and live trees with heart rot that fisher need for resting and denning. In addition, other late successional and mature forests may provide lower densities of very large trees, snags, and down woody material over time. Vegetation standards for the Canada lynx would also benefit fisher because they address retention of multi-storied hare forests with a dense understory providing hare habitat and limit regeneration harvest within a lynx analysis unit, which is similar in size to a fisher home range. Plan components for riparian areas would also promote fisher habitat and its connectivity. Alternatives vary with respect to plan components to increase future old growth, its connectivity, and the resilience of very large trees, but all alternatives have plan components to support key ecosystem characteristics for the fisher.

In order to assess key aspects of fisher habitat, effects of alternatives on NRV, current conditions, and effects of alternatives were modeled by Ecosystem Research Group (Appendix 3). The natural range of variation (NRV) was modelled going back about 1000 years and effects of alternatives were projected for the next 50 years, including anticipated changes in climate. ERG modelled fisher habitat based on Olson's characteristics (Olson et al. 2014). Fisher denning and resting habitat was modeled as forests with an average DBH class greater than 10", since trees in this class on the mesic habitats of the Forest generally have an average height greater than 65 feet tall (consistent with the Olson models). Cover types in the moist habitat type groups with presence of western larch, Douglas-fir, western hemlock, western red-cedar, and cottonwood, which may provide cavities used for resting and denning, were included. High elevation habitat types were excluded because annual precipitation falling as deep, fluffy snow is believed to be too high for use by fisher. Forest with a canopy cover class less than 15% was excluded from fisher habitat based upon the definition of an opening by Sauder and Rachlow (2014). Fine scale habitat selection includes determining the presence of very large snags and large down wood. VMap data used by the model does not provide information on these variables, but ERG's query design used FIA data to assess the probability of snag occurrence (see appendix 3).

The model indicates that historically, there was a wide range of natural variation of modelled fisher habitat of about 350,000 acres (resulting largely from wildfire). In the future, the model predicts all alternatives would stay within the minimum and maximum range of NRV over the 5 decade time period. Modelled habitat occurs on up to about 600,000 acres and is distributed across much of the forest, but the model is not able to consider the distribution of very large snags or down wood providing high-quality resting and denning habitat within a home-range sized area. Nevertheless, the overall trend can be projected.

ERG's results show that acres of modelled fisher habitat initially increases by the end of the first decade and then declines back to current levels by decade 5 with all alternatives. Because this trend occurs with all alternatives, much of the modelled decline is likely attributable to wildfire and/or the high amount of insects/disease portrayed in the model, both of which would cause widespread mortality of trees in the very large size classes (associated with a warmer and drier climate by decade 5). Insects and disease or fire produces snags and down woody material which increase fisher habitat quality, provided canopy cover provided by live trees does not decrease too much. However, the model predicts declines that are likely a function of reduced canopy cover to levels below that which fishers require. Alternative B declines a little more than the other alternatives, likely because modelled outputs for this alternative regenerate more acres during the first decade to reduce stand densities in the WUI portions of the warm, moist biophysical setting. None of the alternatives model timber harvest in RHCAs or RMZs, where much of the modelled fisher habitat in the cool-moist habitat groups occurs. Patch size, patch distribution, and distance between patches would be analyzed at the project level, as would presence of very large snags, live trees with heartrot, and down woody material (see appendix C for possible strategies).

Environmental consequences alternative A

The 1986 Forest plan does not have management direction specific to fisher, but does provide direction for management of old growth, snags, and down wood as described above. Riparian Habitat Conservation Areas also have management direction that promotes habitat conditions that would support fisher and provide connectivity. Access management standards for the grizzly bear would benefit fisher by promoting retention of very large snags and down wood in areas that might otherwise be accessible to firewood cutters.

Environmental consequences alternatives B, C, and D

In addition to the modelled effects of treatments by alternatives, forestwide desired conditions, standards, and guidelines for forest structure (including snags, down woody material, and old growth) as well as plan components for Riparian Management Zones, support existing fisher habitat, future fisher habitat, and fisher habitat connectivity. Key ecosystem characteristics described in the affected environment would be supported by implementation of coarse filter plan components for coniferous forests included in all action alternatives, as detailed in the general section on "Old Growth Habitat, Very Large Live and Dead Trees" and in vegetation section 3.3.

Guideline FW-GDL-WL-SCC-03 states that vegetation management prescriptions in the warm-moist biophysical setting (excluding the portion with a ponderosa pine dominance type) and in the portion of the cool-moist biophysical setting within RMZ's, should promote development of very large (20 inches dbh or larger) live, dead, and down trees including large western larch, western red cedar, and western hemlock to provide habitat for maternal denning and resting by fisher.

In the cool-moist biophysical setting, where fisher modelled fisher habitat is primarily associated with riparian areas, RMZ standards are beneficial to fisher because they promote cover and habitat connectivity. For example, the total width of an RMZ is 300 feet on each side of a perennial fish-bearing stream or 300 feet from a lake, pond, or wetland shoreline.

Standard FW-STD-RMZ-02 states that vegetation management activities proposed within RMZs are to be consistent with state law (e.g. Montana Streamside Management Zone Law; see appendix C) and standard FW-STD-RMZ-03 states that vegetation management can only occur in the **inner** RMZ when necessary to maintain, restore or enhance aquatic and riparian associated resources and to meet RMZ desired conditions. These standards would promote fisher habitat and its connectivity. Standard FW-STD-RMZ-04 states that vegetation management can only occur in the outer RMZs, so long as project activities in RMZs do not result in long-term degradation to aquatic and riparian conditions. On a site-specific basis, for example, this standard may allow the forest to use pre-commercial or commercial thinning to promote the growth of large diameter trees in heavily stocked stands to increase the patch size of future fisher habitat where it does not conflict with other resources. In addition, access management standards for the grizzly bear would also benefit fisher by limiting access for firewood gathering, promoting retention of very large snags and down wood (see grizzly bear section of DEIS Chapter 3).

Cumulative consequences

Most of the modelled fisher habitat is in the warm-moist biophysical setting at low elevations in the Swan Valley GA, along the reservoir in the Hungry Horse GA, and in northern portions of the Salish Mountains GA (see Forest Assessment 2014). The Salish Mountains and Swan Valley GAs have lots of private lands intermingled with Forest lands, as well as state lands. DNRC manages old growth according to the Administrative Rules of Montana for forest management (36.11.418 biodiversity - old growth management), which directs the department to manage old growth to meet biodiversity and fiduciary objectives. The department considers the role of all stand age classes, consistent with the range of natural disturbances, when designing harvests and other activities to maintain biodiversity. Old growth was constrained in DNRC's 2015 sustainable yield calculation such that 8% of forest stands on lands managed by their Northwestern and Southwestern land offices are to meet the minimum quantifiable definitions of old growth by Green et al. 1992 (and as amended). The project level considerations of DNRC complement those of the Forest with respect to maintenance of old growth habitat, very large live and dead trees to support wildlife. Whether patch size and connectivity of fisher habitat would increase depends upon specific locations of existing old growth as well as locations of future treatments, which is difficult to predict. How climate change and stand-replacing wildfires will affect fisher habitat in the future is also difficult to predict (also see cumulative consequencess on old growth forest, very large live and dead trees on all lands, discussed above).

Under Olson's various models of future fisher habitat with respect to climate change, there is a gain of suitable habitat in the mountainous areas of Glacier National Park and areas south of Kalispell. However, there are uncertainties associated with these models because fisher must also be able to disperse if their habitat shifts. If fishers are unable to achieve regular dispersal distances greater than about a mile through unsuitable farmland or developed valley habitat, Olson and others predicted that the total area of available habitat would actually decline over time (Olson et al. 2014). Riparian areas on all lands may help to provide dispersal routes. The preliminary Northern Region Adaptation Partnership climate change risk assessment for fisher (NRAP 2015) estimated that the magnitude of effects would be low in 2030 and moderate in 2050 (consistent with ERG modelling results), with a high likelihood of effects across all time periods.

Timber harvest and public fisher trapping do not occur in Glacier National Park, but extensive wildfires have occurred there since the 1980's. Fisher have not been detected in the Park during non-invasive sampling efforts in in recent years (John Waller, pers. comm. 2016), indicating that factors other than timber harvest or trapping may be primarily responsible for low fisher numbers or absence of fisher on all lands. The future of fisher trapping on all lands is uncertain. MFWP manages trapping regulations, adjusting regulations to meet population and harvest objectives for fisher. Glacier National Park, encompassing about a million acres adjacent to the Forest, would continue to be closed to trapping.

In summary, the cumulative consequences of plan components on the Forest, in the context of all lands of the larger landscape, contribute to the ecological integrity of mature and old growth forest habitats that support fisher resting and denning, and provides a mosaic of forest age classes to support fisher prey species. This would be accomplished by plan components to maintain existing old growthand promote development and retention of very large live, decayed and dead trees. The abundance and distribution of fisher habitat on the Forest is naturally limited by elevation, topography, climate, habitat types, and natural processes such as stand-replacing wildfires. Modelled habitat on the Forest does not occur in the broad, expansive pattern that is characteristic of forests with more of a strongly maritime climate. While the Forest does not have the ecological capacity to provide more contiguous, large blocks of habitat, or authority over all stressors that may affect the fisher (such as trapping), the Forest contributes to the ecological conditions that support them.

Pileated Woodpecker

Key indicators for analysis

There are no species-specific plan components for pileated woodpeckers because key ecosystem characteristics described in the affected environment would be supported by implementation of coarse filter plan components discussed in the vegetation sections 3.3.5, 3.3.7, 3.3.8 and 3.3.10 and in "coniferous forests in a variety of successional stages", "old growth habitat, very large live and dead trees >20" dbh," and "coniferous forest; and snags less than 20" dbh". The following section discusses how these plan components support key ecosystem characteristics for the pileated woodpecker

Affected environment

Population, distribution, habitat, and life history: The pileated woodpecker is distributed across portions of southern Canada, most of the eastern U.S., the northern Rocky Mountains, and the west coast. The pileated is the largest woodpecker in northwest Montana and is easy to detect. Pileated woodpeckers are regularly detected on annual surveys of the Forest for "integrated monitoring in bird conservation regions", but occur in relatively low number and density (IMBCR 2015) so there are no statistically reliable trends available. There have been numerous observations of this species across all geographic areas on the Forest in the last decade (MNHP database 2013).

Pileated woodpeckers are primary excavators, drilling large cavities in very large snags or live trees with heartrot for nesting and creating cavities that are used as habitat by numerous other species for nesting, denning, roosting and resting once they are abandoned by the pileated woodpecker. Pileated woodpecker habitat occurs at a wide range of elevations and they occur in all forested biophysical settings of the Forest except cold. Pileated woodpeckers have a relatively large home range (100-1000 acres), incorporating diverse forest structure and composition. In Montana, pileated woodpeckers select larch for nesting more frequently than other tree species, followed by ponderosa pine, black cottonwood, aspen, western white pine, grand fir, and lastly, Douglas-fir (McClelland and McClelland 1999). Snags selected for nesting are very large diameter (≥20-inch dbh) and ≥40 feet tall (Bull 1987; McClelland 1977). Bull and Holthausen (1993) found that Pileated Woodpecker abundance increased as the amount of forest without logging, >60% canopy closure, and large old trees increased. Nest trees averaged 28.7 inches DBH and often had broken tops. Large trees, logs, snags, carpenter ants and heartwood decay (which may enter the tree through deep fire scars) are components of forests that sustain pileated woodpeckers. Thomas (1979) estimated a maximum pair density of 0.3 pairs per 100 acres with a requirement for 14 snags greater than 20 inches dbh per 100 acres for the Blue Mountains of Oregon and Washington.

In recent decades, many forests inhabited by pileated woodpeckers have changed considerably from large continuous areas of mature and old forests with dense canopy cover (Bull and Holthausen 1993) to relatively open canopies (<30% closure) with an increasing number of snags and logs as a result of increased levels of insect infestation (Bull et al. 2007). Bull and others (2007) studied the density of nesting pairs and traditional home ranges of pileated woodpeckers in two study areas over a 30-year period, and in five additional study areas over 15 years after extensive insect-caused tree mortality and timber harvest during the 1990's. Although canopy closure declined due to tree mortality in 5 of the 7 areas they studied and some of the forests were no longer classified as old growth, they continued to function as habitat for woodpeckers because of the nesting, roosting, and foraging habitat provided.

Key stressors are the same as those listed under the section on "Old Growth Habitat, Very Large Live and Dead Trees" because pileated woodpeckers occur across the full range of these habitats on the Forest.

Summary of alternative consequences

All alternatives have plan components that would support key ecosystem characteristics for the pileated woodpecker, because all existing old growth would be retained and would provide the very large snags and live trees with heartrot that pileated woodpeckers need for nesting. In addition, other successional stages may provide lower densities of very large trees, snags, and down woody material over time. Alternatives vary with respect to plan components to increase future old growth and the resilience of very large trees, as described below, but all alternatives have plan components to support key ecosystem characteristics for the pileated woodpecker.

In order to assess key aspects of pileated woodpecker habitat, effects of alternatives on NRV, current conditions, and effects of alternatives were modeled by Ecosystem Research Group (Appendix 3). The natural range of variation (NRV) was modelled going back about 1000 years and effects of alternatives were projected for the next 50 years, including anticipated changes in climate and the fire suppression logic of the model. Modelled habitat included forests with average VMAP diameter classes greater than 15 inches d.b.h. and greater than 15% canopy cover, with species mixes including western larch, ponderosa pine, black cottonwood, and Douglas-fir for nesting. Although pileated woodpeckers use very large-diameter snags and live trees with heart rot for nesting, the SIMPPLLE model is dependent upon R1-VMap and did not allow the incorporation of very large snag densities. The Forest used FIA summary data to determine the number of acres with at least 8 or 10 large (15–19.9-inch DBH) and very large (>20-inch DBH) trees per acre (depending on habitat type group). A VMAP texture file was then used to spatially map those acres. FIA data were also evaluated to ensure that sufficient large snags exist at the forest scale to provide nesting habitat, assuming random distribution. FIA summary data suggests snags 15-20 inches DBH (used primarily for feeding) occur at approximately four per acre, and snags >20 inches DBH (used primarily for nesting) occur at approximately one per acre.

The model predicts all alternatives would stay within the minimum and maximum range of NRV over the 5 decade time period. Future acres of modelled habitat varies little between alternatives and remains close to current levels which are at the middle of the range of NRV. Acres of habitat increase slightly and consistently through decade 5. Since pileated woodpeckers can utilize forests that are relatively open, fires, insects, and disease have little negative effect as long as stands retain large and a few very large trees. The combined modeled acreage of large trees used for feeding and very large trees used for nesting increases slightly through the 5-decade period. Changes in the distribution of cover types for suitable nest trees, which include western larch, ponderosa pine, Douglas-fir and western red-cedar, suggest those preferred nest trees will also increase slightly through the period (for black cottonwood see the section on hardwood trees above). The substantial amount of modeled fire, insects and disease, contribute to both nesting snags and foraging snags that would increase habitat suitability for pileated woodpeckers by the end of decade 5, regardless of alternative selected.

Environmental consequences alternative A

The 1986 Forest plan does not have management direction specific to pileated woodpecker, but does provide direction for management of old growth, snags, and down wood as described above.

Environmental consequences alternatives B, C, D

Key ecosystem characteristics described in the affected environment would be supported by implementation of coarse filter plan components for coniferous forests included in all action alternatives, as detailed in the general section on "Old Growth Habitat, Very Large Live and Dead Trees". The snag analysis shows that the percentage of the forest with at least one snag per acre greater than 20" dbh increases by the 5th decade under all alternatives, which would be beneficial for pileated woodpeckers (see effects on snags and down wood in the Vegetation section of chapter 3 for more details).

Wildlife associated with burned forest and dead trees less than 20 inches d.b.h.

Key indicators for Analysis

In addition to key indicators addressed in vegetation section 3.3 and coniferous forest habitat sections of the DEIS, the following indicators are important for the wide variety of wildlife species associated with old growth habitats and very large live and dead trees. The indicators were developed after considering key stressors, public comments, and issues identified during scoping.

- Plan components to support key ecosystem characteristics for species associated with burned forest snags <20" dbh and burned forest.

Introduction

This section discusses habitat for species associated with burned forests and/or snags less than 20" dbh. Examples of key ecosystem characteristics of burned forests are very high densities of dead trees for nesting, an enhanced insect prey base following fire-induced tree mortality, and open canopy and understory conditions when compared to unburned coniferous forests. The black-backed woodpecker, American three-toed woodpecker, hairy woodpecker, northern flicker, and olive-sided flycatcher are all more abundant in intensively burned than unburned mixed-conifer forest because of an abundance of food (beetle larvae and ants) and potential nest sites associated with large numbers of standing dead trees (Hutto and Young 1999;Hutto et al. 2015). A reduction of nest predators after high-severity fire is also a plausible and likely reason for high survival of cavity nesters in burns (Saab and Vierling 2001, Saab et al. 2004, Saab et al. 2007), especially small mammals (Fisher and Wilkinson 2005).

Refer to appendix D for a full list of wildlife species associated with these habitats. Desired characteristics of recently burned forest are described in the section 3.3.

In burned conifer forests, the most valuable wildlife snags are more likely to be thick-barked species such as ponderosa pine, western larch, and Douglas-fir than thin-barked Englemann spruce, true firs, and lodgepole pine tree species (Hutto 1995; Saab & Dudley 1998). Thick-barked snags in burned forests provide feeding opportunities as well as nesting opportunities for birds. Woodpeckers feed extensively on wood-boring beetle larvae in the snags (Hutto 2006). Some seed-eating bird species also increase after fires due to the increased availability of seed resources. Species such as the Cassin's finch, red crossbill, and pine siskin take advantage of seeds that are released or made available in cones that open after severe fires. Cassin's finches are one of the more abundant birds in early post-fire conifer forests, where their numbers can increase significantly regardless of fire severity (Casey et al. 2013).

Secondary cavity nesting species such as the northern hawk owl, mountain bluebird, western bluebird, house wren, and tree swallow benefit from new forest openings in a complex of snags of many diameters within burned forest (Hutto et al. 2015). About 25% of all bird species nesting in the northern Rocky Mountains are cavity nesters and are dependent upon disturbances such as fire, insects, and disease to create habitat (McClelland and others 1979).

As described in the old growth section, snag densities used for standards or guidelines in the Revised Forest Plan are based upon information used in the development of Amendment 21, which came from a comprehensive publication on managed forests (Thomas 1979). Table 36 displays the number and preferred species of snags per 100 acres needed to support 100% of the maximum population of two example woodpecker species found on the Forest.

Table 35. Snags per hundred acres by dbh class to meet the needs of key primary excavators in the mixed conifer community (from Thomas 1979)

Species	Maximum pair density/100 acres[1]	Preferred Snag Species	Average number of Snags
Northern flicker	2.5	Aspen, western larch, ponderosa pine	38 per hundred acres > 12" dbh (3.8/ac.)
Black-backed woodpecker	1.3	Engelmann spruce, western larch, aspen	59 per hundred acres >12" dbh in clumps (5.9/ac.)

1 –based upon territory size

While the snag numbers listed by Thomas may be adequate for nest sites, subsequent studies have stressed the importance of leaving many more dead trees in burn areas in to provide food for species that feed on insects in dead trees that are in close proximity to nest sites. Saab and others (2007) studied the effects of salvage logging and time since fire on cavity nesting birds. For most species, the time since fire and postfire treatment (partially logged vs. unlogged) had little influence on nesting survival. The salvage logging was designed to retain more than half of the snags over 9 inches dbh, which provided suitable nesting habitat for open-space foragers during the decade following fire. Nest densities of wood-foraging species and mountain bluebirds were significantly higher in unlogged burn areas, whereas Lewis's woodpeckers and kestrels had significantly higher nest densities in partially logged burn areas. Western bluebird nest densities were nearly equal in both logged and un-logged burned areas (Saab et al. 2007).

Hutto and Gallo found that there were 8 species that nested in severely burned areas with salvage logging, but there were 10 species where nesting was only detected in areas without salvage harvest. They also compared bird abundance in severely burned areas that had salvage logging with areas that had not had salvage logging. They found that birds were more abundant in unsalvaged areas, likely due to more abundant dead trees that provided food (Hutto and Gallo 2006).

With respect to specific bird species, Saab and others (2007) found that nest densities of northern flickers generally increased with time since fire, whereas nest densities of black-backed and hairy woodpeckers peaked 4–5 years postfire.

Affected environment

On the Forest, snags of all sizes and downed woody material provide essential habitat features for about 60 species of birds, mammals, and amphibians. Of the 60 species, there are about 15 species on the Forest that are strongly associated with burned forests for feeding and/or breeding (See Appendix D of Revised Forest Plan). These species are associated with a variety of environmental conditions that occur with snags or burned forests. Two of the species associated with burned forests and/or dead trees less than 20 inches dbh with are specifically addressed as examples in this section in order to help display differences in effects of alternatives, but effects to other species associated with these habitats are similar. These species are the black-backed woodpecker and olive-sided flycatcher. For detailed information on the population and life history of these species refer to the Montana Field Guide online (http://fieldguide.mt.gov) and the Montana Partners in Flight Bird Conservation Plan (Casey 2000).

Modeling of NRV across the Forest shows that stand-replacing wildfire has fluctuated greatly over the last 1000 years, due to cycles of warm, dry climate versus cool, moist climate. Because over 60% of the Forest is in the cool, moist to cold biophysical settings, the majority of stand-replacing wildfires the greatest acreage has been in these biophysical settings (see Forest Vegetation section for more details). Wildlife species that use burned forest habitats may experience population fluctuations that correspond to habitat fluctuations, but they are adapted to these wide fluctuations in habitat availability.

The acreage of burned forest on the Forest has increased a great deal in recent decades compared to previous decades (table 37) and is now in a similar to the pattern to that seen from 1890-1930. Recent wildfires have created abundant habitat for species associated with burned forests (see fire section 3.8 of DEIS Chapter 3 and the Forest Assessment for more details).

Table 37 shows the acres burned on Forest lands from 1980-2013. Most of this acreage burned at moderate to high severity, but the exact acreage is unknown. Of the total acres burned, about 60% was in Wilderness and about 40% was outside of Wilderness. About 90,000 acres burned more than once. In comparison, from 1889-1920, about 1,200, 000 acres was mapped as being burned (with a huge spike in 1910), but the amount of unburned area within burned perimeters is unknown and mapping was at a much coarser scale.

Table 36. Approximate acres burned by wildfire on the Forest from 1980-2013

1980-1989	1990-1999	2000-2009	2010-2015
16,400 acres	42,450 acres	338,700 acres	146,600 acres

Burned forests provide a very high density of snags, but snags also occur at high density in unburned areas with high levels of insect and disease. Modeling of NRV across the Forest shows that insect and disease levels have also fluctuated over time and across the landscape (see vegetation section 3.3 of DEIS for more details).

At the broader scale of USFS Region 1, a report providing estimates of snags and large, live tree densities for national forests was completed by Bollenbacher and others (2009) using the FIA summary database. Data indicated that snag distribution is uneven across the landscape at any given point in time, leading to a broad range in confidence intervals when trying to interpret the natural range of variability for snag densities. The mean density of snags in the 15 inches d.b.h. and larger category ranged from about 2.6 to

13.7 snags per acre for forests that were not dominated by lodgepole pine. The average is increased by the very large number of snags in burned forests. Because acres burned by wildfire vary widely from decade to decade and from place to place, average snag densities should viewed at a landscape scale.

Table 38 displays an estimate of the current density of snags less than 20 inches d.b.h. across the Flathead Forest. Additional tables displaying estimates across smaller analysis units composed of groupings of vegetation dominance types and potential vegetation types can be found in the Assessment of the Flathead National Forest (2014).

Table 37. Current snag densities on the Forest inside and outside wilderness/roadless areas.

	Snags per acre ≥10 in. d.b.h.			Snags per acre ≥15 in. d.b.h.		
Analysis Unit	**Mean**	**Lower bound**	**Upper bound**	**Mean**	**Lower bound**	**Upper bound**
Outside Wilderness	9.8	7.4	12.5	2.6	1.8	3.4
Inside Wilderness	10.0	7.8	12.4	2.8	2.2	3.5

Research specific to the Forest looked at a stratified random sample of 49 stands and analyzed 10 variables that might be related to snag density and distribution (Wisdom and Bate 2008). Mean snag density for all species was found to be 19 times higher in unharvested stands compared to clearcuts and 3 times higher than stands that had undergone partial harvest (Wisdom and Bate 2008). This study found that factors significantly affecting snag density included seral stage, timber harvest, distance to the nearest town, proximity to open roads, and whether the stand was uphill or downhill from the nearest road. Salvage of burned trees has occurred on only about 10% of the burned acreage on the Forest in recent decades, so abundant habitat has been available for use by a wide variety of wildlife species associated with this habitat (see vegetation section of Forest Assessment for more details).

The affected environment section above describes key ecosystem characteristics. The key stressors section which follows provides a foundation for the alternative effects analysis and an understanding of which stressors the USFS has authority to manage. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are activities that might impact a species and its habitat if not managed or mitigated. Stressors that are outside of Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. These are considered under “cumulative consequences”.

Key stressors under USFS Control

<u>Land Management:</u> Fire policy of the USFS affects decisions on suppression of wildfires. Availability of firefighters and firefighting equipment has a large impact on fire suppression, especially during years when wildfires are abundant across the nation (see Fire section 3.8 of the DEIS for more details). Vegetation management on NFS lands affects the intensity and extent of insect and disease outbreaks that create snags and down woody material, ability to manage wildfire spread, snags remaining in timber harvest areas and snags remaining in wildfire areas (see vegetation section 3.3 of the DEIS for more details). Public firewood gathering and the size/species of snags lost.

Key stressors NOT **under USFS Control**

<u>Climate Change:</u> Warmer, drier summer climate is expected to increase stand replacement fires and insects/disease.

Land Management: private lands are generally managed to suppress wildfires and insect outbreaks, resulting in fewer snags

Summary of alternative consequences

There are over 1 million acres of the Forest that are existing Wilderness distributed across the Hungry Horse, Swan Valley, South Fork and Middle Fork Flathead River Geographic Areas. The relative abundance and variation in size of snags within this area would be expected to be very high.

In the wildland-urban interface (figure B-15), wildfires would generally be aggressively suppressed. These factors would tend to result in a lower density of snags. Lands suitable for timber production are more concentrated in portions of the Salish Mountains and Swan Valley GAs, where there are also more acres in the wildland-urban interface. With the exception of existing old growth, lands suitable for timber production would generally be managed in a way that improves their growth and vigor and limits losses due to insects and diseases, where possible. All alternatives include standards for retention of snags in harvest units, where available. The snag retention standards under all alternatives would help provide snags and downed wood important for many wildlife species, including those in areas managed for timber production.

As snags fall, they would provide abundant down woody material over time. The distribution of down woody material would be variable, as influenced by the pattern of insect, disease, fire and harvest. Like snags, the highest amounts are expected to occur in un-roaded areas, such as backcountry management areas, designated and recommended wilderness areas. Lower amounts of downed wood are expected to occur on lands identified as suitable for timber production (see the timber products section of chapter 3 for more details). Down wood retention guidelines are included in all alternatives and these are expected to be sufficient to meet desired conditions for wildlife.

Effects of alternatives were modelled using the Spectrum model. This model showed that future forest conditions were driven primarily by fire, insects and disease—all of which create snags. Trends in forest conditions indicative of snag densities are the same under all alternatives as modeled over five decades, though the degree of change varies somewhat between the alternatives. Snags in the 10 to 20 inch d.b.h class increase substantially in all alternatives, with the percentage of the forest having snag densities of over 10 per acre initially increasing from 10 percent to 19 percent. By decade 5, at least 28 to 33 percent of the Forest is modelled as having snag densities of over 10 per acre in the 10 to 20 inch size class. Desired conditions for snags and downed wood are expected to me met forestwide under all alternatives and there would be abundant habitat for cavity nesting and denning wildlife species at a forest-wide scale. For cumulative consequences on other land ownerships, see the sections on coniferous forests, since these are similar. Also see the individual “cumulative consequences” sections for specific species below.

Lands where timber harvest may be allowed is defined by management area and desired conditions. The Spectrum model does not account for salvage harvest, but salvage harvest could occur on lands suitable for timber production as well as lands not suitable for timber production. Salvage of dead trees may be allowed (on lands not suitable for timber production) on 19 percent of the Forest with alternative A, 17 percent with alternative B, 16 percent with alternative C and 21 percent with alternative D. Salvage harvest levels and locations would depend upon acres burned by wildfire or trees killed by insect/disease, as well as other resource limitations, so whether it would actually occur or not is highly uncertain. Under alternatives B and D, approximately one-half of these acres are comprised of inventoried roadless areas where salvage harvest is often not economical.

Environmental consequences alternative A

The forest would continue to implement forest plan direction benefitting species associated with snags (see section 3.3 for more details), because the plan specifies retention of an average of 2 snags per acre in the 12-20 inch size class in the dry potential vegetation group and an average of 6 per acre of this size in the moist and cold potential vegetation groups (in areas more than 200 feet from open roads). This average number would meet the needs of species such as flickers for the moist and cold potential vegetation groups. In the dry potential vegetation group, the specified number would be lower than the desired average of 3.8 per acre indicated for maximum populations of species such as the flicker. If existing snag densities are below the specified numbers, live trees are to be substituted where available. The forest plan does not have management direction for burned forests. The plan also specifies that an average of 15 pieces of down woody material in the 9-20 inch size class be retained per acre in the dry potential vegetation group and 30-32 in the moist or cold potential vegetation groups. This management direction provides habitat to support wildlife species associated with dead trees and down woody material. The snag analysis shows that the percentage of the forest with at least 10 snags per acre in the 10-20" dbh size class would be highest with alternative A in the first decade, but that this pattern would not continue in later decades. Since there is no direction in the plan to retain residual mature trees in seedtree or shelterwood harvest units, trees contributing to future snags and down wood could be removed from harvest areas.

Environmental consequences alternatives B, C and D

All action alternatives include FW-DC-TE&V-24 which states that moderate to high severity, recently burned forest conditions are distributed throughout the Forest, varying widely in amount, pattern and frequency over time and space. Recently burned forest conditions are most consistent with NRV in wilderness areas and larger unroaded areas, which will have the majority of acres and the largest patch sizes. Outside these areas, moderate to high severity burned forests will occur over much less acres overall and mostly in relatively small patches (e.g., less than 500 acres). Recently burned sites support an abundance of native grasses, forbs and shrubs, along with low to very high densities of fire killed trees. Fire-killed conifers over 20 inches d.b.h. are present for nesting by black-backed woodpeckers and other cavity nesting or denning species within patches 100 acres or larger, and available periodically over time, consistent with NRV. Fire-killed trees over 10 inches d.b.h. are available for feeding by black-backed woodpeckers and other wildlife species associated with burned forests (see appendix D for a full list of species). All action alternatives include FW-GDL-TIMB-03 and 04 which state that when salvaging timber in areas severely burned by wildfire, clusters of burned trees of a variety of sizes should be retained to provide habitat for wildlife species associated with burned habitats (see appendix C since this will vary on a site-specific basis). This guideline would benefit species associated with burned forests, snags, and downed woody material across the forest.

The action alternatives benefit wildlife because they have desired conditions FW-DC-TE&V-16, 17 and 18, which also address benefits to wildlife associated with snags and down wood in timber harvest areas. All action alternatives include standard FW-STD-TE&V 04 which states, "in the absence of a site-specific analysis that supports an alternative prescription for snags or decadent live trees, timber harvest areas shall retain at least the minimum number of snags and/or decadent live trees displayed in the following table 39. The intent is to provide sufficient habitat both short and long term, well distributed across the landscape, for wildlife species associated with snags and decadent live trees, particularly those that are larger and longer lasting (see Appendix C). All western larch, ponderosa pine, and black cottonwood snags greater than 20 inches shall be left. If present, decadent live trees greater than 20 inches d.b.h., especially those with evidence of wildlife use, may be used as a substitute for 20 inch d.b.h. snags, to achieve minimum levels in table 17. Exceptions to this snag retention standard may occur, for example in areas where the minimum number or snags or decadent live trees are not present prior to management activities; where there are issues of human safety (i.e., developed recreation sites); and in areas within 200 feet of a road that is open to firewood cutters. Refer to Appendix C for guidance on implementing this snag retention guideline".

Table 38. Snag levels to retain (where they exist) in timber harvest areas

Biophysical setting	Minimum number of snags per acre	
	≥ 15 inches d.b.h.[ab]	≥ 20 inches d.b.h.[c]
Warm-Dry	3	1.4
Warm-Moist	8	2
Cool-Moist/Mod. Dry	5	2
Cold	3	1

a. This minimum number includes snags greater than or equal to 20 inches d.b.h.

b. If snags greater than 15 inches are not available, then snags greater than 12 inches should be retained.

c. If snags greater than 20 inches are not available, then additional snags or decadent live replacement trees greater than 20 inches d.b.h. should be left if available.

The specified numbers would exceed the desired average of 3.8 per acre greater than 12 inches dbh indicated for maximum populations of species such as the flicker. The snag analysis shows that the percentage of the forest with at least 10 snags per acre in the 10-20" dbh size class would be highest with Alternative C by the 5th decade. Alternative C has the highest percentage of the Forest in recommended wilderness, where fire, insect, and disease would be more prevalent and salvage harvest would not occur (see section 3.3 for more details).

Cumulative consequences of all alternatives common to most species associated with burned forests, dead trees and down woody material

This section summarizes activities and effects that are common to most species associate with dead tree (snag) and down woody habitats. Also see the individual "cumulative consequences" sections for specific species. Past management actions, particularly timber harvest and fire suppression, altered coniferous forest stand structure and reduced the density of dead trees, decreasing the diversity of post-fire forests (see vegetation section 3.3 for more details).

Within the boundaries of the Forest analysis area, there are three state forests, as well as scattered parcels, managed by Montana Department of Natural Resources and Conservation (DNRC). DNRC harvests timber on state lands and manages snags according to the administrative rules of Montana for forest management (36.11.411 biodiversity - snags and snag recruits). This management direction specifies the number of snags per acre that are to be retained in harvest units, by habitat type group, and in consideration of the wildland urban interface. On state lands, administrative regulations require retention of a minimum of 2 snags per acre on wet habitat types and 1 snag per acre on dry habitat types ≥21 inches dbh, or the next largest size class available. If snags are lacking, large live trees can be substituted. The project level considerations of DNRC complement those of the Forest with respect to retention of snags in harvest units to support wildlife.

Past fire suppression (followed by salvage logging when fires or insect/disease outbreaks did occur) altered the availability and pattern of habitat for species that nest, roost, and/or den in cavities in snags and down logs on portions of the Forest. Under the action alternatives, there is more flexibility to use fire for habitat restoration/maintenance (see section 3.8 for more details). Continued fire suppression is anticipated in the wildland-urban interface on NFS lands and on private lands. On DNRC forest trust lands in the Swan Valley GA, the Stillwater State Forest in the Salish Mountains GA, and Coal Creek State Forest lands in the North Fork GA, wildfires are likely to be suppressed.

As a result, stand replacing wildfires, high snag densities, and widespread or high levels of insect/disease are likely to be much lower in the wildland-urban interface (which overlaps much of the warm-dry and warm-moist biophysical setting) than in the cool-moist and cold biophysical settings that are dominant outside the wildland-urban interface. Timber harvest, prescribed burning and precommercial thinning used for fuels reduction in the warm-dry and warm-moist biophysical settings that are dominant within the wildland-urban interface on all lands would restore/maintain stand density conditions to those nearer historic conditions and make forests more sustainable and resilient to large-scale disturbance, but may not restore snag levels to historic conditions. On state and private timber lands, as well as NFS lands in areas managed for timber production, many of the dead trees are likely to be salvaged if they have economic value, but snag requirements would still be met.

Past road building on federal, state and private lands likely impacted the distribution and number of snags, especially within 200 feet of open roads, but road influences have decreased over time. Access management has resulted in fewer routes open to motor vehicle use on federal, state, and private lands, helping to protect snags and burned forest. Glacier National Park, where there is no public firewood cutting, encompasses about 1 million acres adjacent to the Forest.

Increases in insects/disease and wildfire are likely to affect all lands if the climate becomes warmer and drier in the future. On the Flathead NF and in Glacier National Park, the number of snags and acreage of forest burned with stand-replacing wildfire has increased since 1988 and this trend is likely to continue. On the Forest's wilderness lands and in Glacier National Park, there is virtually no salvage of burned forest or snags killed by insects and disease on a combined area of over 2 million acres, so diverse forests with a large number of snags will continue to provide high quality habitat for species associated with these key ecosystem characteristics.

In summary, the cumulative consequences of proposed management direction on the Forest, in the context of all lands of the larger landscape, contributes to burned forest and snag habitat. This would be accomplished by plan components to allow natural ecosystem processes to occur on over 1 million acres across the forest. While the USFS cannot control all stressors that affect burned forest wildlife habitat, and while fire suppression on all lands would continue to be needed to protect life and property, plan components would help to promote the ecological sustainability of NFS lands while also providing for economic and social sustainability.

Black-backed woodpecker

Key indicators for analysis

The public expressed an interest in this species during scoping. There are no species-specific plan components for black-backed woodpeckers because their needs are addressed by coarse filter plan components described above. In addition to the plan components, indicators, and effects described for "old growth habitat, very large live and dead trees >20 inches dbh"; "coniferous forest and snags less than 20" dbh" described above, the following section assesses effects to the black-backed woodpecker resulting from management direction for burned forests.

Affected environment

Population, life history, habitat, and distribution: The black-backed woodpecker is distributed across most of Alaska, southern Canada, the Great Lakes region, and the mountain ranges of the northwest U.S. and California. Black-backed woodpeckers are associated with boreal and montane coniferous forests that have experienced recent burns or large-scale bark beetle outbreaks. Black-backed woodpeckers are known to use three types of forested habitat: 1) post-fire areas that have burned within one to six years, 2) areas with extensive bark beetle outbreaks causing widespread tree mortality, and 3) areas of smaller disturbances scattered throughout the forest caused by wind throw, ice damage, or other occurrences that produce small patches of dead trees. These conditions all provide habitat for the black-backed woodpecker's primary food source, woodborer beetles, and larvae.

Successful breeding is known to be closely tied to fires that kill large numbers of trees to provide nest sites for this cavity-nesting species and subsequent presence of wood-boring beetles for feeding (Hutto and Gallo 2006)(Dixon and Saab 2000). In an Oregon forest with a bark beetle epidemic, overall nesting success averaged 68.5 percent (Goggans et al. 1988). In contrast, nest success was 100 percent and 78.6 percent for nests monitored in burned forests of western Idaho and central Oregon, respectively (Saab and Dudley 1998, Forristal 2009). Populations of this species are known to increase for up to a decade following stand replacement fires and decrease during periods with fewer stand replacement fires (Nappi and Drapeau (2009).

At a landscape scale, moderate to intensively burned forest patches that have trees at least 9" dbh and at least 50% crown closure prior to burning provide nesting habitat for black-backed woodpeckers (Forristal 2009). Following wildfires, some trees are instantly killed, others die slowly over a decade or so, and others are able to survive fire. Similarly, use of burned areas by black-backed woodpeckers changes over time (Forristal 2009). Forristal found that black-backed woodpecker populations peaked 2-3 years following wildfire. Hutto (pers. comm. 2012) stated that burned forest habitat is valuable for black-backed woodpeckers for up to a 10-year period following stand-replacing wildfires if trees continue to die over time.

In northwest Montana, it is likely that black-backed woodpecker populations have increased since 2003 due to the large number of acres that experienced high intensity burns during this period. Black-backed woodpeckers are highly mobile and appear to migrate at least 30 miles to recent burns (Hoyt 2000). Dudley and Saab (2007) estimated an average home range size of about 511 acres of high-quality habitat per nesting pair.

Key stressors are the same as those listed under the section on burned forest and snags <20" dbh because black-backed woodpeckers occur across the full range of these habitats on the Forest. Key ecosystem characteristics described in the affected environment would be supported by implementation of coarse filter plan components for coniferous forests included in all action alternatives.

Summary of alternative consequences

On the Forest, there are over 1 million acres of existing wilderness where natural ecosystem processes will prevail, including wildfire. Within wilderness, about 835, 000 acres are in potential vegetation groups capable of providing black-backed woodpecker habitat. There would be no salvage harvest in Wilderness, so abundant, high-quality habitat would be available following wildfires with all alternatives. Alternatives vary with respect to the amount of recommended Wilderness, as described below.

Outside wilderness, wildfires are likely to be aggressively suppressed in the wildland-urban interface, resulting in lower acreages or lower quality habitat for black-backed woodpeckers on about 400,000 acres of National Forest System Lands. The mix of vegetation management activities, as well as plan components for salvage harvest, varies by alternative, as described below, but all alternatives have plan components to support key ecosystem characteristics for the black-backed woodpecker, including retention of snags in timber harvest units.

In order to assess key aspects of black-backed woodpecker habitat, effects of alternatives on NRV, current conditions, and effects of alternatives were modeled by Ecosystem Research Group (Appendix 3). The natural range of variation (NRV) was modelled going back about 1000 years and effects of alternatives were projected for the next 50 years, including anticipated changes in climate and the fire suppression logic of the model. Modelling of black-backed woodpecker habitat included all forested habitat groups and cover types except high elevation alpine cover types (WB, WB-ES-AF, and AL-WB-AF), including tree size classes 10 inches dbh or greater.

The model predicts all alternatives would stay within the minimum and maximum range of NRV over the 5 decade time period. The natural range of variation (NRV) of modelled habitat for black-backed woodpeckers historically ranged from about 10,000 to 270,000 acres out of approximately 2.4 million acres on the Forest, a moderate range of about 260,000 acres. Although many acres have burned, high quality habitat lasts for less than a decade, so the current level is about 130,000 acres—slightly above the minimum of NRV.

In the future, modelled acres of habitat increases somewhat and then declines back to current levels by decade five. Even though the mean acres of black-backed woodpecker habitat increases, the level of habitat never reaches the maximum range of NRV, or even the acres burned in the 2003-2012 time period due to modelled effects of fire suppression. However, the fire suppression logic of the model may not be realistic given anticipated future climate conditions and there may actually be more acres burned by stand-replacing fire than the model predicts.

Environmental Consequences Alternative A

The 1986 Forest plan does not have management direction specific to black-backed woodpeckers, but does provide direction for management of old growth, snags, and down wood as described above.

Environmental Consequences Alternatives B, C, D

Key ecosystem characteristics described in the affected environment would be supported by implementation of coarse filter plan components for burned forests as described above. Salvage within burned forests to meet desired conditions may occur in certain circumstances, as described in other sections of this forest plan (see forest vegetation products in the timber section and suitability determinations under each management area). FW-GDL-TIMB-03 would help to retain black-backed woodpecker habitat in salvage harvest areas. This guideline states, “When salvaging timber in areas severely burned by wildfire, clusters of burned trees with a variety of sizes should be retained to provide habitat for wildlife species associated with burned habitats (see appendix C for possible strategies, since this will vary on a site-specific basis)”.

Cumulative Consequences

Black-backed woodpeckers have persisted on the Forest and on other land ownerships within and adjacent to the Forest even though there were very few acres of stand-replacing wildfire from the 1940’s to the 1980’s. Their populations may occur at low levels during these time periods and increase greatly during periods when acres burned by wildfire are at a high level. Black-backed woodpeckers readily cross forest boundaries to exploit far away burns (Hoyt 2000).

Fires have been active on the Flathead and adjacent forests in the last two decades. Black-backed woodpeckers are likely to find high-quality habitat as they move from forest to forest to inhabit areas burned with stand replacing fire. As stated in the burned forest section above, some of the areas burned by wildfire that are accessible by road on all land ownerships are likely to continue to have salvage harvest of dead trees, but there is a combined area of over 2 million acres in Glacier National Park and the Forest's wilderness (figure 1-01), inventoried roadless (figure B-02), and back-country areas where forests burned by stand-replacing wildfires would continue to provide high-quality habitat for black-backed woodpeckers. In addition, although forests with insect infestations do not provide the high-quality habitat that areas with stand replacing fires do, the acres of forest with high levels of insect infestation are expected to increase with a warmer and drier climate and are likely to support black-backed woodpecker populations at lower densities.

Olive-sided flycatcher

All alternatives have standards or guidelines for retention of live trees and snags in harvest units which benefit habitat quality for olive-sided flycatchers. In addition to indicators and plan components for coniferous forest and burned forest discussed above, ERG interpreted effects of alternatives on modeled olive-sided flycatcher habitat.

Affected environment

The breeding range of the olive-sided flycatcher is across most of Alaska, southern Canada, the western and eastern U.S., and the Great Lakes region. It is a small neo-tropical migratory bird known to breed in western Montana and winter in Mexico and South America. Olive-sided flycatchers are generally restricted to coniferous or mixed-coniferous forests that include a juxtaposition of forest openings and mature forest providing edge, and the presence of snags (although they are not cavity nesters). They can be found in dry to moist sites across a range of elevations. Occurrence of olive-sided flycatchers is influenced by relatively open canopies and the presence of tall trees for aerial flycatching/foraging, and perches for singing (Altman and Sallabanks 2012). In mixed conifer forests and in red-cedar-western hemlock forests in Idaho, they were found to be significantly more abundant in a matrix of clearcuts than in landscapes of old-growth forest (Evans and Finch 1994; Hejl and Paige 1994). Hutto and Young (1999) found Olive-sided Flycatchers were more abundant in early post-fire habitats than in any other major cover type, although they had similar occurrence in seed tree cover types, and were only slightly less common in clear-cut and shelterwood cover types, occurring more frequently in disturbed than in undisturbed forest in the northern Rocky Mountains. Intermediate successional stages (e.g., dense even-aged sapling-pole or mature forests) are generally not suitable (Kotliar 2007).

Key stressors are the same as those listed under the section on burned forest and snags <20" dbh. Key ecosystem characteristics described in the affected environment would be supported by implementation of plan components for burned forests included in all action alternatives, as detailed above.

Summary of Alternative Consequences

In order to assess key aspects of olive-sided flycatcher habitat, effects of alternatives on NRV, current conditions, and effects of alternatives were modeled by Ecosystem Research Group (Appendix 3). The natural range of variation (NRV) was modelled going back about 1000 years and effects of alternatives were projected for the next 50 years, including anticipated changes in climate and the fire suppression logic of the model. To determine both the mid-seral forest as well as openings that olive-sided flycatchers require, mixed species forests with two distinct tree size classes were examined:

- The 0–5-inch DBH size class: all canopy covers 15–100%
- The >9-inch DBH size class: 15% - 69.9% canopy cover

In addition, the following assumptions were made. Olive-sided flycatchers require edges between openings and stands of mature forest. Analysis of seedling/sapling habitat (at all canopy cover levels) adequately represented openings in the landscape. The relative abundance of the seedling/sapling habitat and mature forest habitat was assessed in the time series modeling results. ERG assumed that if the ratio of seedling/sapling to mature forest stays within NRV (as defined by Losensky 1995) over the five-decade period, then olive-sided flycatchers will not be at risk. If either openings or mature forests drop to levels below NRV, then olive-sided flycatchers would be determined to be at risk. Some forest patches modeled as providing habitat for Black-backed woodpeckers may also provide habitat for Olive-sided flycatchers. Olive-sided flycatchers may be found to be at no risk at the planning unit scale, but will be at risk in certain landscapes for a given time period as a consequence of larger-than-normal wildfires.

The model predicts all alternatives would stay within the minimum and maximum range of NRV over the 5 decade time period. Acres of habitat vary little between alternatives. The range between maximum and minimum levels of habitat is relatively large which parallel the maximum levels of modeled fire thorough the five-decadal period (not surprising since this is a fire-dependent species). The natural range of variation (NRV) of modelled habitat ranges from about 450,000 to 1.3 million acres out of approximately 2.4 million acres on the Forest, a large range of about 850,000 acres. In the future, acres of habitat increases continuously thru decade five. There are minor differences in alternatives, because wildfire, prescribed fire, commercial thinning, and timber harvest can all create the habitat conditions this species requires. Consequently, even considering some uncertainty in the degree to which forests burn versus succumb to insects and disease in the future, modelled habitat for olive-sided flycatchers is abundant on the Forest.

Cumulative consequences specific to the black-backed woodpecker and olive-sided flycatcher

In addition to cumulative consequences discussed above, the following species-specific effects apply to these two bird species.

In the future, areas outside the wildland-urban interface in the cool-moist and cold biophysical settings are likely to have stand replacing wildfires that would create high quality habitat for black-backed woodpeckers and other fire associates such as the olive-sided flycatcher. However, habitat acres are likely to be highly variable from decade to decade, because forests in these biophysical settings have a tendency to burn with high severity on a median fire return interval of 100 years or more (Sneck 1977).

In the future, more and larger, bark beetle outbreaks, as well as higher wood-boring beetle populations and more seeds found in burned areas, would provide abundant food sources. However, as wood-boring beetles and bark-beetles decline, the habitat quality of stands killed by fire or insect/disease would decline. Black-backed woodpeckers persist between fires and insect outbreaks, but at lower densities. Because olive-sided flycatchers feed on insects in the air, more open canopy conditions occurring after fire could facilitate feeding for a much longer period of time. Because black-backed woodpeckers and other birds adapted to post-fire conditions are generally mobile species, they are able to move to new locations as vegetation changes with changes in climate and fire (USDA FS 2010).

3.7.5 Threatened, endangered, proposed and candidate wildlife species

Introduction

There are two threatened wildlife species on the Flathead National Forest; the grizzly bear and Canada lynx (USFWS list 4/20/16), as well as Canada lynx critical habitat. There are no wildlife species that are proposed for listing or candidates for listing under the ESA at this time. In addition to the legal and administrative framework described in the beginning of the wildlife section, the following applies to all threatened and endangered species.

On the Forest, federally listed threatened and endangered species and their critical habitat would continue to be managed and protected in accordance with requirements of the Endangered Species Act, Forest Service policy, recommended protection measures in the recovery plans, and all applicable state and federal laws. This DEIS assesses indirect and cumulative effects of plan components included in the revised Forest Plan and its alternatives, whereas direct effects would be addressed through the site-specific assessment process. Consultation with the USFWS on listed species plan components will take place at the programmatic level, whereas consultation on implementation will take place at the project level, as needed.

Grizzly bear

Introduction

The grizzly bear was listed as a threatened species in the lower 48 states in 1975, under the Endangered Species Act (USFWS 1993). The Grizzly Bear Recovery Plan (USFWS 1993) identified recovery goals, objectives, and tasks necessary for recovery of the species. In 2011, the USFWS completed a 5-year status review, and estimated that the overall population size had increased to about 1,500 grizzly bears in the lower 48 States (USFWS 2011). Grizzly bears exist in four identified recovery zones: Northern Continental Divide, Greater Yellowstone, Cabinet-Yaak, and Selkirk. Of these, the Northern Continental Divide Ecosystem supports the largest grizzly bear population.

All alternatives are designed to conserve the grizzly bear. The action alternatives provide the regulatory framework to support a recovered Northern Continental Divide Ecosystem (NCDE) grizzly bear population, within the inherent capability of the plan area and USFS authority (36 CFR 219.1(g). It would be necessary for Flathead National Forest Plan grizzly bear management direction to remain in effect to support grizzly bear recovery during the five year monitoring period following de-listing, as required by the Endangered Species Act. However, grizzly bears are expected to continue to be a “conservation-reliant” species in the NCDE beyond five years (Scott et al. 2005). Therefore, grizzly bear management direction would remain in place throughout the life of the plan, unless amended.

The draft Grizzly Bear Conservation Strategy (USFWS 2013) was developed by multiple agencies to guide management of the entire Northern Continental Divide Ecosystem for grizzly bears. The Forest plan components incorporate portions of the draft Grizzly Bear Conservation Strategy (USFWS 2013) relevant to habitat management on NFS lands. While National Forest System lands provide a majority of the habitat for grizzly bears in portions of the NCDE area, grizzlies are a wide-ranging species affected by activities on private and other agency lands that can have impacts on their survival and distribution. Forest plan components such as standards and guidelines apply to only those lands under Forest Service jurisdiction.

Plan components are written to conform to the 2012 planning rule and alternatives were developed, consistent with the National Environmental Policy Act (NEPA). The USFS coordinated and consulted with the USFWS throughout the process of developing plan alternatives and will continue to do so throughout the NEPA process.All alternatives consider Forest ecosystems, key ecosystem characteristics, and conditions to support a recovered grizzly bear population. Alternatives are based upon public and agency comments, differing in the range of future actions that could occur.

Key indicators for analysis

The Draft Grizzly Bear Conservation Strategy (GBCS)(USFWS 2013) identified six key ecosystem characteristics and human activities relevant to management of the National Forest System lands that have the greatest potential to impact grizzly bears. These are: (1) the amount and distribution of secure habitat, (2) motorized route densities, (3) developed recreation sites, (4) livestock allotments, (5) vegetation management, and (6) mineral and energy development. The analysis of effects of the alternatives is focused on these six aspects of grizzly bear habitat in the NCDE (see Volume 1 for Flathead National Forest; see Volume 3 for the other four forests and cumulative consequences). In addition, the framework of the grizzly bear management zones is designed to address grizzly bear-human conflicts and connectivity on all lands in the NCDE, so the effects of plan components on connectivity for grizzly bears is also a key indicator.

In addition to key indicators addressed in other sections of the DEIS, the grizzly bear indicators were developed after considering key stressors, public comments, and issues identified during scoping. The biological basis for key ecosystem characteristics and impacts of human activities is described in more detail in the affected environment section and in the draft Grizzly Bear Conservation Strategy (USFWS 2013).

Methodology and analysis process

The diversity of habitats for grizzly bears on the Forest are reflected in the "aquatic", "ecosystems and vegetation," and "wildlife" sections of the Assessment; in the plan components of the revised Forest Plan (2016); and in sections 3.2, 3.3, and the wildlife diversity sections of this DEIS. The plan alternatives are assessed in terms of differences in vegetation composition, structure, function, pattern, and connectivity. Coarse filter plan components addressed in the wildlife diversity section of Chapter 3 provide for habitat diversity that also benefits grizzly bears. Appendix C of the revised forest plan includes potential management approaches to promote grizzly bear foods and other habitat conditions.

Spatial and temporal analysis

The analysis area for indirect effects is the geographic areas of the Forest. Because grizzly bears are wide-ranging and the decision to be made encompasses five national forests, the analysis area for grizzly bear cumulative effects encompasses the area defined in the Draft Grizzly Bear Conservation Strategy (USFWS 2013) including zones providing connectivity to other grizzly bear ecosystems (see DEIS Volume 3 for cumulative consequences to the grizzly bear).

Land area delineations for management of grizzly bears in the NCDE have changed from 1986 to the present, based upon the best available scientific information about grizzly bear populations and habitat occupancy. When the 1986 Flathead Forest Plan was developed, grizzly management direction applied to the recovery area (the same area now known as the PCA), which was further divided into areas mapped as Management Situations (MS) 1, 2, and 3. Management direction for each management situation was specified in the Interagency Grizzly Bear Guidelines (Forest Plan unbound appendix OO; map on page II-24).

The majority of the Forest was mapped as MS-1 and MS-2, where grizzly bear habitat management was emphasized. MS-3 was mapped in areas with human developments, where grizzly-human conflict management was emphasized (table 40).

Table 39. Acres of management situations 1, 2, and 3 within and outside the NCDE recovery zones under the 1986 Forest plan, as amended.

National Forest	Management Situation (MS) 1 in NCDE recovery zone	MS 1 outside recovery zone	MS 2 in NCDE recovery zone	MS 2 outside recovery zone	MS 3 in NCDE recovery zone	MS 3 outside recovery zone
Flathead	2,022,688	–	99,418	–	12,614	–

This management direction also stated that management situation stratification would be refined based on current grizzly bear habitat suitability, population, and distribution trends. Changes to management situation stratifications would be made by amending or revising the Forest Plan.

New stratifications, called grizzly bear management zones, have now been developed and are incorporated into the draft plan and the action alternatives (see figure B-01, grizzly bear management zones). The primary conservation area (PCA) is the same as the original recovery zone, but is no longer stratified into management situations. The primary conservation area and the Forest's portion of zone 1, (including the Salish Demographic Connectivity Area (DCA)(see figure B-01, Flathead National Forest NCDE management zones), encompasses the basic area of the current, known grizzly bear population and its distribution on the Forest (Costello et al. 2016, in press) and is the spatial analysis area for indirect effects. Each of the management zones has unique grizzly bear management goals, as detailed in the Grizzly Bear Conservation Strategy.

The temporal analysis considers indirect effects of activities that may occur during the anticipated life of the forest plan, about 15 years. However, because certain USFS actions and environmental conditions have the potential to affect grizzly bears for longer time periods, the temporal analysis for cumulative effects discuses changes that occur over a longer time period of several decades. When projections are made further into the future, the level of uncertainty for potential consequences rises. Past actions were considered in the description of the affected environment and its existing condition.

Information sources

Information on the amount and distribution of secure core habitat, motorized route densities, developed recreation sites, and livestock allotments was updated in 2014 by the NCDE GIS specialist, based upon input from multiple land managers within the NCDE. Some data has changed since publication of the draft Grizzly Bear Conservation Strategy due to better knowledge of on-the-ground conditions, re-alignment of GIS data layers, etc. Information on Flathead National Forest mineral and energy development, as well as vegetation management (e.g. fire, timber harvest, fuels reduction, thinning, planting), was obtained from a variety of sources, as explained in the Flathead National Forest Assessment (2014) and appendix 2 of the DEIS (also see planning record exhibit V-13).

Information sources and incomplete or unavailable information

The NCDE conservation strategy provides a compilation of the best available science, but is currently a draft document. The Grizzly Bear Conservation Strategy (GBCS) is expected to be finalized in time for the USFS to consider it while completing its FEIS.

The road inventory used for calculations of the Forest road densities and security habitat for grizzly bears is based upon the USFS INFRA database. The USFS does not have complete knowledge of its old road system or the status of all roads on adjacent private lands. However, the USFS periodically updates the INFRA database on roads as new aerial images and data become available. The planning process used the best available information.

The USFS has also updated its information on developed recreation sites since the draft GBCS was published, but information on dispersed recreation sites is not available. Most of the Forest is open to dispersed recreation so the sites, as well as the amount of use or season of use, are ever-changing.

Affected environment

Grizzly bear population ecology, biology, habitat descriptions, and relationships identified by research are described in detail in the literature cited, summary of best available scientific information (BASI), and elsewhere in the planning record. The following description of the affected environment provides a summary in the context of the NCDE, focusing on the Flathead National Forest and information that is necessary to understand the consequences of the alternatives (40 CFR.1502.15). Detailed information regarding grizzly bears across the Northern Continental Divide Ecosystem (NCDE) can be found in the grizzly bear section of the DEIS Volume 3.

Grizzly bear population and life history

Ongoing research indicates the NCDE contains the largest population of grizzly bears in the lower 48 states. The NCDE population of grizzly bears is contiguous with grizzly bears in Canada, resulting in high genetic diversity (Proctor et al. 2012). The agencies involved in development of the grizzly bear conservation strategy agreed that changes in multiple grizzly bear demographic rates (e.g. population growth, mortality, survival) would be estimated by MFWP and the USFWS, in order to indirectly monitor the health of the grizzly bear population and the NCDE ecosystem.

The Grizzly Bear Recovery Plan (USFWS 1993) identified a minimum NCDE-wide grizzly bear population of 391 bears. As of 2004, Kendall and others (2009) confirmed that the known number of individual bears exceeded recovery goals and estimated there were about 765 grizzly bears in the NCDE. In 2014, the population estimate for the NCDE is 960 grizzly bears with an estimated population growth rate is 2.3% per year (Costello et al. 2016, in press).

All estimates indicate that the NCDE grizzly paper population is growing. Costello's analyses result in estimates that differ slightly from Mace et al. (2012; Table 5.1) and led to a slightly lower estimate of the annual rate of population growth ($\lambda = 1.023$) for the NCDE grizzly bear population than that previously reported ($\lambda = 1.031$; Mace et al. 2012). Costello and others stated, "We do not believe the observed difference in the two estimates is a result of actual population change. Our current models include a covariate for trend, and no negative trend was observed in any of the vital rates. Rather, we believe that the differences between Mace et al. (2012) and this report can be attributed to: (1) an increase in sample sizes for estimation of all vital rates; (2) better representation of conflict females in the estimation of vital rates; and (3) subtle but significant differences in methods of analysis".

Grizzly bear mortality and survival in the NCDE affects population growth and is influenced by age, sex, reproductive status, and home range location (e.g. proximity to human developments). Mortalities have a variety of causes and fluctuate from year to year, but despite mortalities, the survival rate for adult females (the most important group affecting population trend), is high at 0.947: with a 95% confidence interval of 0.919–0.972 (Costello et al 2016, in press).

In the NCDE, the most frequent known causes of documented human-caused mortalities of independent-aged grizzly bears during 2004–2014 were listed as management removals, poaching/malicious kills, and defense of life. Accounting for the fact that management removals were documented with 100% accuracy, whereas other deaths often go unreported, Costello et al. (2016, in press) estimated that poaching/malicious kills likely accounted for the highest proportion of total independent bear mortality (27%), followed by management removals (16%), illegal defense of property (11%), and natural causes

(9%). The majority of management removals result from conflicts at sites associated with frequent or permanent human presence (USFWS 2013 Draft Grizzly Bear Conservations Strategy). Unsecured grizzly bear attractants on private lands such as chicken coops, garbage, human foods, pet/livestock foods, bird food, livestock carcasses, wildlife carcasses, barbeque grills, compost piles, orchard fruits, or vegetable gardens are usually the source of these conflicts. Walters and Holling (1990) stated that managing human-caused mortality, monitoring both population and habitat parameters (e.g. road access), and responding when necessary with adaptive management, are the best ways to ensure a healthy grizzly population.

Grizzly bear densities within the NCDE PCA vary, but are generally highest in Glacier National Park and on adjacent national forest lands (including the Forest), decreasing toward the southern portion of the ecosystem (Kendall et al. 2009). Grizzly bears are large animals with high metabolic demands during the non-denning season. Adequate nutritional quality and quantity are important factors for successful reproduction. Mace and Roberts (2013) found that grizzly bear diets include more animal matter towards the southern and eastern periphery of the NCDE and include more plant matter in the northern and western portions of the NCDE. This pattern is presumed to reflect, at least in part, natural environmental gradients across the NCDE that influence habitat productivity.

Teisberg and others studied grizzly bear population health and body condition, finding that adult females across all ecoregions of the NCDE enter dens at mean fat levels above those thought to be critical for cub production. They stated that there is no evidence to conclude that the widely varying food resources across the NCDE are inadequate to meet the needs of reproductively-active adult females. As truly opportunistic omnivores, grizzly bears in all regions of the NCDE exploit diverse combinations of food items to arrive at productive body conditions (Teisberg et al. 2015).

Grizzly bear home ranges overlap and change seasonally, annually, and with reproductive status. The grizzly bear population density estimate inside Glacier National Park is approximately one bear per 8,154 acres (Kendall et al. 2008). Mace and Roberts (2012) evaluated home ranges of 34 female grizzly bears that lived in or adjacent to Glacier Park, based upon data collected from 2004-2011. Most home ranges (59%) straddled the Park boundary, overlapping lands managed by the Flathead National Forest, the Lewis and Clark/Helena National Forest, and the Blackfeet tribe. Home ranges were, on average, smallest for bears that lived 100% within the Park, and larger for females that straddled the Park boundary.

To facilitate the assessment of grizzly bear population recovery objectives, the NCDE grizzly bear recovery zone was subdivided into smaller units called bear management units (see figure 01-57, NCDE bear management units). Twenty-three bear management units were delineated in the NCDE and 12 of these are located on or partially on the Flathead National Forest (figure 1-32). There is wide distribution of grizzly bears across the NCDE bear management units (Kendall et al. 2009, Mace and Roberts 2011). Mace and Roberts (2015) mapped the distribution of grizzly bears in the NCDE (see figure 1 in volume 3, NCDE grizzly bear distribution). The grizzly bear population has now expanded well beyond the recovery zone, another indication of population growth. The current distribution is 21,313 square miles, covering the entire recovery zone, most of zone 1, and parts of zones 2 and 3 (Costello et al. 2016, in press). Costello and others evaluated occupancy of the 23 bear management units in the NCDE by females with offspring during 2004–2014. Using the 6-year running tally as set forth in the Recovery Plan (USFWS 1993), they documented full occupancy of the recovery zone starting in 2009 and continuing until 2014. In addition, using similar methods, they documented full occupancy throughout areas of zone 1 (Costello et al. 2016, in press).

While monitoring and research has shown that the distribution of the NCDE grizzly bear population is clearly increasing, some members of the public expressed concern about genetic connectivity within the NCDE, or between the NCDE and other grizzly bear ecosystems. Genetic connectivity of grizzly bear populations has been examined at multiple scales. At an international scale, Proctor and others (2012) studied connectivity between the U.S. and Canada, using genetic testing and movement data from radio-collared grizzly bears, with data gathered between 1979 and 2007. Both male and female grizzlies moved freely across the US/Canadian border on the northern edge of the NCDE, (including the Forest). They concluded there is currently little risk of significant reduction in the present high levels of genetic diversity in the NCDE grizzly bear population (Proctor et al. 2012). Within the NCDE, few barriers to grizzly bear genetic exchange appear to exist. Both male and female movements have been documented across existing highway corridors. Researchers concluded that habitat connectivity is within levels that ensure both demographic and genetic connectivity (Miller and Waits 2003, Waller and Servheen 2005).

The draft Grizzly Bear Conservation Strategy also addresses genetic connectivity between U.S. grizzly bear ecosystems. (see volume 3 for more details on connectivity between the NCDE and other grizzly bear ecosystems, including the affected environment and cumulative consequences sections on connectivity).

The Flathead National Forest is located within the northwest Montana portion of the NCDE on the west side of the continental divide. Zone 1 on the Flathead National Forest contains a portion of the Salish Demographic Connectivity Area (DCA). The Salish Demographic Connectivity Area has an objective to provide genetic connectivity between the NCDE and the Cabinet-Yaak Grizzly Bear Ecosystem to the west, through occupancy by female bears, but at a lower density then in the primary conservation area. The Salish Demographic Connectivity Area is currently occupied by female grizzly bears (Mace and Roberts 2015, Costello and Roberts 2016). On the Forest, grizzly bears occupy an area of the recovery zone/primary conservation area totaling over 2.1 million acres and an area outside the recovery zone/primary conservation area (Zone 1) totaling about 230,000 acres (table 41). In total, the Flathead National Forest comprises nearly 40% of the NCDE grizzly bear recovery area or primary conservation area (USFWS 2013).

Table 41 displays the approximate acreage in each geographic area (GA) on the Flathead National Forest within grizzly habitat management zones.

Table 40. Grizzly management zones within geographic areas (GAs) on the Flathead National Forest

Grizzly Habitat Classification	North Fork GA	Middle Fork GA	South Fork GA	Hungry Horse GA	Salish Mtns GA	Swan Valley GA	Total Forest
Primary Conservation Area	319,998	370,156	789,074	286,229	6,781	490,824	2,136,534
Salish Demographic Connectivity Area	0	0	0	0	95,840	0	95,840
Zone 1 outside DCA	43	0	0	5	135,516	143	135,702
Outside NCDE	0	0	0		24,722		24,722

Grizzly Bear Habitat

Grizzly bears are habitat generalists that use the wide variety of habitats on the Forest. The quantity and quality of grizzly bear habitat within the Forest's geographic areas consists of a diverse, ever-changing vegetation and landscape mosaic providing a variety of foods, cover conditions, habitat security, and habitat connectivity. The natural range of habitat variation is based on our knowledge of the past and our understanding of ecological processes (e.g., fire, floods, avalanches, insects, and disease)(also see Appendix 2 and section 3.3 of the DEIS for a discussion of the current abundance and distribution of vegetation compared to ecological reference conditions and the natural range of variation).

Habitat and grizzly bear foods

The search for energy-rich food appears to be a driving force in grizzly bear behavior and habitat selection. Grizzly bears are known to switch foods according to which foods are available (Servheen 1981); Kendall 1986; (Martinka and Kendall 1986); (Mace and Jonkel 1986); (LeFranc Jr. et al. 1987); (Aune and Kasworm 1989). Grizzly bears will consume almost any food available including living or dead mammals or fish, insects, worms, plants, berries, human-related foods, and garbage (Knight, Blanchard, and Mattson 1988)Mattson et al. 1991; Schwartz et al. 2003). Mattson and others (1991) hypothesized that grizzly bears are always sampling new foods in small quantities so that they have alternative options in years when preferred foods are scarce.

Some member of the public have expressed concern that the USFS has not calculated the carrying capacity or food production capability of its lands. Carrying capacity or food production cannot be calculated for an omnivorous and opportunistic species such as the grizzly bear, because they eat a wide variety of foods, with availability that is constantly changing due to factors such as wildfire, plant succession, and annual changes in production due to weather. Grizzly bears are an omnivorous and opportunistic species that has adapted to the natural range of variation, with food habits that can vary annually and even day to day as they adapt to a changing environment (USFWS 2013 Draft Grizzly Bear Conservation Strategy). Increasing bear density influences access to food resources and foraging efficiency, thus bear populations are likely limited by social factors rather than any limitation of food biomass itself (McLellan, B. N. 1994).

Habitat on the Forest provides high diversity of bear foods that meet the needs of grizzly bears as the seasons and available foods change, so they are not reliant on any one food. Habitat includes a variety of coniferous forests, deciduous forests, wetland and riparian areas, and grass/forb/shrub patches found in meadows, avalanche chutes, burned areas, and logged areas (see the other sections of the wildlife diversity analysis in Chapter 3 of the DEIS; Assessment of the Forest, April 2014 for more details). The varying climate, topography, and vegetative conditions on the Forest, (as well as other lands in the NCDE), provide for a variety of habitats and foods to support grizzly bears.

Upon den emergence in the spring, bears in the NCDE may search avalanche chutes for animal carcasses buried by the snow before descending to lower elevations seeking newly emerging vegetation (Servheen 1981); Kendall 1986; (Mace and Jonkel 1986); (Martinka and Kendall 1986); (LeFranc Jr. et al. 1987); (Aune and Kasworm 1989). As snow melts, grizzly habitat use extends to higher elevations. In the western portion of the NCDE, including the Flathead National Forest, riparian and wetland habitats (Ruby 2014) and avalanche chutes continue to be important to bears during summer, and autumn (Mace and Waller 1997). Avalanches regularly occur on the Forest and adjacent areas of the NCDE, restoring conditions that are favorable for grizzly bears (Weaver, J. L. 2014).

During summer, grizzlies may feed on army cutworm moths and ladybird beetles on the rocky talus areas at high elevations of the Forest, as well as on the adjacent Lewis and Clark National Forest, CSKT tribal lands, and GNP lands (Servheen 1983); Klaver et al. 1986)(White et al. 1998) (Sumner and Craighead 1973; (Craighead and Mitchell 1982) (Aune and Kasworm 1989). Once berries become available in the summer, grizzlies consume a wide variety of berries found on the Forest and elsewhere in the NCDE including huckleberries, buffaloberries, serviceberries, hawthorn berries, chokecherries and to a lesser degree alderleaf buckthorn berries and mountain ash (Servheen 1981); Kendall 1986; (Mace and Jonkel 1986); (Martinka and Kendall 1986); (LeFranc Jr. et al. 1987); (McLellan and Hovey 1995). These diverse berry-producing shrubs provide ripe fruit at various times throughout the summer and fall months, ripening at lower elevations first and progressing up slope. The amount and species of berries in bear diets vary annually based on annual fruit production and distribution (McLellan and Hovey 1995).

In northwest Montana, production of berries is affected by forest canopy cover, temperature, and soil moisture conditions, which can vary considerably from low to high elevations and from year to year. Because most of the Forest is heavily forested, wildfire, timber harvest, and other vegetation management activities that affect canopy cover also affect grizzly bear food production. Prolonged drought (that can increase acres burned by wildfire and reduce production of some species of berries) has also occurred during the time period that the grizzly bear population has recovered. Grizzly bears have adjusted to these changes affecting food availability.

Prior to the spread of white pine blister rust, grizzlies in the NCDE fed on whitebark pine seeds from late summer through fall when and where they were available (Shaffer 1971; (Mace and Jonkel 1986); (Aune and Kasworm 1989); (Kendall and Arno 1990). However, data on whitebark pine mortality rates from the early to mid-1990s indicated that 42–58 percent of all whitebark pine trees surveyed within the NCDE were dead (Kendall and Keane 2001) and no longer produced seeds. Recent re-measurement of a subset of the 1990’s plots showed that mortality of whitebark pine trees has more than doubled in the past two decades (NRAP 2015). Despite this loss, the grizzly bear population is increasing, illustrating the flexibility of grizzly bear diets and high habitat diversity in the NCDE)(Draft Grizzly Bear Conservation Strategy; USFWS 2013).

Grizzly bears are also known to feed on animals and hunter-discarded gut piles, especially in the fall. Teisberg and others found that fall diets of NCDE grizzly bears consist of higher amounts of meat (32% for adult males, 21% for adult females)(Teisberg et al. 2015). Adult male grizzly bear diets shifted from 3% to 33% meat from summer to fall in the northwest portion of the NCDE (lower Swan, lower South Fork Flathead, North Fork Flathead, and Whitefish Range). Adult female bears also shifted their diet, but not as much as males (Mace and Roberts 2013).

Habitat security

<u>Habitat security and motorized use in the PCA during the non-denning season</u>: Human activities during the non-denning season can affect habitat availability for grizzly bears and security from human disturbance and/or human-caused mortality. Schwartz and others found that grizzly bear survival in the Greater Yellowstone Ecosystem declined as road density, number of homes, and site developments increased (Schwartz et al. 2010). Maintaining large areas of secure habitat is important to the survival and reproductive success of grizzly bears, especially females (Mace et al. 1999) Schwartz et al. 2010), and is a major goal of the draft NCDE grizzly bear conservation strategy.

Wilderness areas provide a high degree of habitat security for grizzly bears. The NCDE contains large acreages of congressionally-designated wilderness, totaling about 1.1 million acres within the Forest portion of the recovery zone/primary conservation area (figures 1-01). The Wilderness Act of 1964 precludes a variety of activities including road construction, motorized use or mechanized transport, and permanent human habitation (except as specifically allowed by the enabling legislation, such as the Shaefer air strip). New livestock allotments, new mining claims, new oil and gas leases, or other developments in designated wilderness that would impair wilderness character are also prohibited.

The NCDE also contains substantial acreage of inventoried roadless areas (figure B-02), as well as other lands that have little or no permanent human presence or road development. On the Flathead National Forest, a total of about 1.9 million acres inside the primary conservation area is currently designated as wilderness, or inventoried roadless areas, or other backcountry management areas (figures 1-01) that contribute to high levels of habitat security for grizzly bears.

Research studies have used a variety of methods to assess the effects of human uses on habitat security and grizzly bear use. Some older studies looked at motorized road use based upon data obtained with weekly telemetry flights, while some newer studies used satellite technology to track a bear's location each half hour or hour. Some studies assessed effects to grizzly bears of all sex, age, and reproductive classes, while others assessed effects on each class. A summary of the history of management of habitat security for grizzly bears is provided in this section, in order to understand the context of and rationale for alternatives (see planning record exhibits V-14 and V-15for more details).

The Interagency Grizzly Bear Committee (IGBC) established definitions and procedures for analyzing the effects of motorized use, delineating analysis areas that were equivalent to the average size of a female grizzly bear home range. In the NCDE, these were called bear management unit [BMU] subunits. The IGBC recommended criteria for open and total road densities, as well as core habitat within a grizzly bear subunit, to support conservation and recovery of grizzly bears (U.S. Forest Service 1994). These recommendations were used as the basis for the percentages for open and total road density and security core for the Flathead Forest Plan amendment 19, adopted in 1995.

The Forest's 12 bear management units in the recovery area/primary conservation area were further subdivided into 73 subunits (see figure 1-32). The A19 decision applied management direction to to 54 subunits. Amendment 19 established management direction to reduce impacts of forest management activities on grizzly bears (especially females), by adopting the following for subunits where the USFS managed more than 75% of the acres in a subunit:

1. a 19% limit on open motorized access density (OMAD), also known as open motorized route density (OMRD);
2. a 19% limit on total motorized access density (TMAD), also known as total motorized route density (TMRD), and
3. a minimum of at least 68% security core habitat in this select set of grizzly bear subunits, using a moving window analysis (U.S. Forest Service 1995).

In 1998, the NCDE access task group, a group of grizzly bear experts, suggested that (1) the basic premise of managing open and total road densities, as well as security core areas during the non-denning is valid; (2) although A19 is considered effective for managing access in grizzly bear habitat to support recovery of the species, other strategies may also be effective; and (3) seasonal road closures to protect seasonally important grizzly bear habitat can be useful and effective. Since 1998, many other studies of grizzly bear habitat use in relation to roads have been conducted, using a variety of definitions, methods, and statistical techniques.

McLellan studied the interaction of roads, human activities, and food sources for grizzly bears over a 30-year time period, in a multiple-use landscape in British Columbia that had high levels of human activity (including logging, gas exploration, and grizzly bear hunting). McClellan stated that a significant implication of his study is that the abundance of a high-energy food source growing in undisturbed portions of his study area enabled the grizzly bear population to increase in spite of intense industrial development and with the highest density of hunter-killed grizzly bears in British Columbia. Once the high-energy food source declined, the grizzly bear population declined because of reduced reproduction (either directly or indirectly). He stressed that managers should identify which high-energy foods are important in various ecosystems and try to maintain or enhance these foods while reducing human access into habitats where they are abundant (McLellan 2015).

In summary, while research methods and findings have changed over the years, numerous studies have documented that excessive open road densities in grizzly bear habitat during the non-denning season lowers their survival rate (Mattson et al. 1987, Shackleton (McLellan and Shackleton 1988), McLellan and Shackleton 1989, (Waller and Mace 1997), Mattson et al. 1996, Boulanger and Stenhouse 2014)(see planning record exhibit V-14 for more details).

<u>Summary of habitat security trends in the primary conservation area during the non-denning season</u>: In 1995 there were many more miles of open and total roads than there are today. In 1995, 16 of the Forest's 40 subunits with >75 percent NFS lands met or exceeded 68 percent security core habitat. By 2013, the number of subunits exceeding 68 percent security core had almost doubled (see table 42 for more details). In summary, habitat conditions for grizzly bears on the Flathead National Forest have greatly increased availability of secure grizzly bear habitat, as well as its connectivity (see figure 1-37 and 1-38)(2013 Annual Flathead National Forest Plan Amendment 19 Implementation Monitoring Report and Responses to Amendment 19 Revised Implementation Schedule Terms and Conditions, March 2014).

As of 2013:

- a total of about 711 miles of road had been decommissioned,
- thirty-three (33) of 40 subunits with >75% NFS lands met or were less than 19% OMRD and TMRD (or met amended standards),
- thirty-one (31) of the 40 subunits with >75% NFS lands met or exceed 68% core or amended standards.

The Flathead National Forest habitat now supports a recovered grizzly bear population, even though 19% OMRD, 19% TMRD, and 68% core levels have not been achieved in every subunit, as displayed in table 42 and table 43.

Table 41. Status of bear management unit (BMU) subunits where National Forest System lands totaled >75% of the acres when amendment 19 was adopted (2014 A19 Report)

#	BMU Subunit Name	RD	OPEN Motorized Access Density[1] (% ≥1.0 mi/mi^2)	Total Motorized Access Density[1] (% ≥2 mi/mi^2)	Security CORE (%)
1	Frozen Lake	GV	10	4	80
2	Ketchikan	GV	16	3	72
3	Upper Trail	GV	14	4	88
4	Lower Whale (amended 37-19-47)	GV	36	17	50
5	Upper Whale Shorty	GV	12	11	86
6	Red Meadow Moose	GV	25	17	68
7	Hay Creek	GV	25	16	55
8	Coal and South Coal	GV	15	19	73
10	Werner Creek (amended 29-19-63)	GV	29	20	63
11	Lower Big Creek	GV	18	19	71
12	Canyon McGinnis (amended 19-33-53)	GV/TL	19	32	51
17	Peters Ridge	HH/SL	52	25	34
19	Swan Lake	SL	39	26	45
25	Crane Mountain	SL	31	58	25
31	Beaver Creek	SL	6	26	66

#	BMU Subunit Name	RD	OPEN Motorized Access Density[1] (% ≥1.0 mi/mi²)	Total Motorized Access Density[1] (% ≥2 mi/mi²)	Security CORE (%)
32	Doris Lost Johnny (amended 57-19-36)	HH	57	19	36
33	Wounded Buck Clayton (amended 27-30-65)	HH	27	30	65
35	Emery Firefighter	HH	19	20	58
36	Riverside Paint	HH	18	16	71
37	Jewel Basin Graves	HH	19	19	68
38	Wheeler Quintonkon (amended 25-19-68)	HH/SB	25	19	68
39	Logan Dry Park	HH/SB	30	36	51
40	Lower Twin	SB	9	2	92
41	Twin Creek	SB	0	0	100
42	Moccasin Crystal	HH	8	1	81
43	Stanton Paola	HH	8	3	81
44	Dickey Java	HH	9	0	81
45	Long Dirtyface	HH	0	0	100
46	Tranquil Geifer	HH	0	2	85
47	Skyland Challenge	HH	20	17	65
48	Plume Mtn Lodgepole	HH/SB	0	0	97
49	Flotilla Capitol	HH/SB	0	0	99
50	Ball Branch	SB	7	12	84
51	Kah Soldier	SB	19	19	68
52	Spotted Bear Mtn	SB	19	19	68
53	Big Bill Shelf	SB	11	6	80
54	Jungle Addition	SB	19	19	68
55	Bunker Creek	SB	5	3	92
56	Gorge Creek	SB	0	0	90
57	Harrison Mid	SB	1	0	95

OMAD is also called OMRD (Open Motorized Route Density) and TMAD is also called TMRD (Total Motorized Route Density)
Subunit met amendment 19 or amended motorized access density parameter

Conditions on the Forest have changed since amendment 19 was adopted. At that time, there were 14 subunits that had less than 75% national forest ownership (table 43). These subunits were not required to meet 19% OMAD-19% TMAD-68% security core, but were managed with the additional guidance of the Swan Valley Grizzly Bear Conservation Agreement (see planning record exhibits V-16 thru V-19 for more details). This agreement had additional restrictions on the timing of timber harvest activities that were coordinated between Montana Department of Natural Resources and Conservation (DNRC), Plum Creek Timber Company, and the Swan Lake Ranger District of the Forest. The Draft Grizzly Bear Conservation Strategy addressed the Swan Valley Grizzly Bear Conservation Agreement. The Draft GBCS stated “the Swan Valley Conservation Agreement has coordinated timber harvest activities and associated road management across the multiple land ownerships in the Swan Valley since 1997 and in doing so, contributed to the recovery of the grizzly bear”. As the Draft Grizzly Bear Conservation Strategy also explained, The Nature Conservancy and The Trust for Public Land agreed to purchase lands from Plum

Creek Timber Company and then sell or donate these lands to Federal, State, and private owners. This land transfer is known as the Legacy Project. The vast majority of these lands have become Federal (USFS) or State (DNRC) owned, and any lands that were sold to private owners have safeguards (e.g. conservation agreements) attached to them so that the integrity of wildlife habitat is maintained.

The Forest acquired about 45,000 acres of former Plum Creek Timber Company lands in the Swan Valley through the Legacy Project. Once the USFS acquired these lands, it changed the subunits with greater than 75 percent NFS lands (Table 43).

Table 42. Status of BMU subunits where USFS had <75% National Forest System lands when A19 was adopted[1]

#	BMU Subunit	RD	OPEN Motorized Access Density (% ≥1.0 mi/mi^2)	TOTAL Motorized Access Density (% ≥2 mi/mi^2)	Security CORE (%)
9	State Coal Cyclone	GV	29	25	59
13	Cedar Teakettle	GV	25	27	24
18	Noisy Red Owl	SL	22	17	52
20	South Fork Lost Soup	SL	25	47	41
21	Goat Creek	SL	23	59	39
22	Lion Creek[1]	SL	18	47	41
23	Meadow Smith[1]	SL	20	53	42
24	Buck Holland[1]	SL	24	41	40
26	Porcupine Woodward	SL	28	74	15
27	Piper Creek[1]	SL	19	44	55
28	Cold Jim[1]	SL	18	57	43
29	Hemlock Elk[1]	SL	6	30	64
30	Glacier Loon[1]	SL	22	44	41
34	Coram Lake Five	HH	26	46	14

1 – these subunits now have >75% National Forest ownership due to lands acquired through the Legacy Project over the last few years.

At the time, these lands were also subject to a “fiber agreement” between Plum Creek Timber Company and The Nature Conservancy. Since the Draft Grizzly Bear Conservation Strategy was written, the “fiber agreement” has now ended, so the only remaining parties to the Swan Valley Grizzly Bear Conservation Agreement are the USFS and the Montana Department of Natural Resources and Conservation (DNRC). DNRC may be managing their lands in the Swan Valley using their Habitat Conservation Plan in the foreseeable future (see Volume 3, grizzly bear cumulative effects, for more details). On Flathead National Forest lands, a recent court decision on a specific project determined that amendment 19’s objectives for 19% OMAD, 19% TMAD, and 68% security core would apply in grizzly bear subunits in the Swan Valley where the USFS had acquired 75% or more of the acreage in the subunit through the Legacy Project. This ruling is reflected in the description and assessment of consequences for alternative A, which includes an estimate of the miles of roads and trails that would be closed to public motorized use to meet 19-19-68 in each grizzly bear subunit, unless amended.

In order to assess a range of alternatives, the action alternatives (B, C, and D) assess the consequences of managing all subunits on the Forest (including those in the Swan Valley) with “no net loss” as compared to baseline conditions (see glossary), established by the Draft Grizzly Bear Conservation Strategy (see proposed Forest plan and alternatives). The draft GBCS (USFWS 2013) established management direction based upon baseline conditions because grizzly bear biologists determined that the NCDE grizzly bear population had recovered under those conditions.

Ruby studied grizzly bear habitat use in the Swan Valley based upon location data from 24 radio-instrumented bears from 2000 to 2011. He found that grizzly bears in the Swan Valley did not select against roads with restricted access (Ruby 2014). Even though road density parameters in the Swan Valley did not meet 19-19-68, grizzly bears continued to use Swan Valley habitats.

In their Biological Opinion on Effects of the Flathead National Forest Plan Amendment 19 Revised Implementation Schedule (USDI FWS 2014), the FWS concluded "In summary, the existing access management conditions are good to very good for grizzly bears in the NCDE, with a few site specific exceptions. It is our opinion that motorized access is managed across the NCDE at levels that are evidently conducive to grizzly bear population growth and conserve grizzly bear habitat".

Grizzly bear habitat security and motorized use during the non-denning season in zone 1 (including the Salish DCA):

While a moving-window analysis is used for establishing plan components and analyzing effects of motorized use in the primary conservation area, a different method for establishing plan components and analyzing the effects of motorized use was selected for zone 1 (including the Salish Demographic Connectivity Area), in recognition of the differing grizzly bear management objectives. Instead of a moving window analysis, the linear density of roads or routes open to public motorized use was applied. Linear density is calculated by dividing the miles of roads by the acres of land in a defined area. The evaluation of effects of linear road density on grizzly bears was based on research by Boulanger and Stenhouse (2014). Boulanger and Stenhouse studied 142 grizzly bears monitored in Alberta from 1999-2012. They found that sex and age class survival was related to open road density. The roads in the Alberta study area were almost entirely (96.5%) gravel secondary roads associated with settlements and industrial resource extraction activities. Dr. Stenhouse stated that in Alberta, for the most part, resource roads are all-weather gravel roads that are open for public use year round (see planning record exhibit V-14 and V-15).

Outside the recovery zone/primary conservation area, the 1986 Forest Plan identified geographic units and a range of public open road densities for each (see alternative A discussion). For a map of the geographic units see figure C-26 in the Proposed Action—Revised Forest Plan (March 2015), available online at www.usda.gov/togo/flathead/fpr. Table 44 shows the baseline linear density of roads open to public motorized use within the portions of Zone 1 under management authority of the Flathead National Forest.

Table 43. Baseline density of roads open to the public motorized vehicle use by geographic unit

Geographic Unit[1]	Density of roads open to public motorized vehicle use (avg. linear miles/sections of NFS lands)
Swan Lake Ranger District	
Island Geographic Unit	1.7
Tally Lake Ranger District	
Olney-Martin Creek Geographic Unit	1.6
Upper Good Creek Geographic Unit	1.2
Sylvia Lake Geographic Unit	1.3

Star Meadow-Logan Creek Geographic Unit	1.6
Tally Lake-Round Meadow Geographic Unit	1.7
Mountain Meadow-Rhodes Draw Geographic Unit	1.7
Upper Griffin Geographic Unit	0.85
Ashley Lake Geographic Unit	1.8

[1] see figure C-26 in the Proposed Action—Revised Forest Plan (March 2015), available online at www.usda.gov/togo/flathead/fpr.

This level of motorized access has supported expansion of the grizzly bear population, including females, into zone 1, including the Salish DCA (see figure B-01). Linear densities of roads open to public motorized use are at levels which support survival of both males and females (Boulanger and Stenhouse 2014)(exhibits V-14 and V-15).

Grizzly bear habitat and recreation

Motorized over-snow vehicle use in the primary conservation area

Grizzly bears hibernate in dens during the winter months. Both males and females have a tendency to use the same general area to hibernate year after year, but the same den is rarely reused by an individual (Linnell et al. 2000). The average elevation of 252 grizzly bear dens in the NCDE ranged from 6,427 to 6,906 feet (see planning record exhibit V-21). It has been estimated that about 47 percent (1,648,000 acres) of National Forest System lands in the primary conservation area provides potential denning habitat (R.Mace unpublished data, 2014). The availability of denning habitat is not likely to be a limiting factor for grizzly bears in this area (USFWS 2013).

The impacts of winter recreation activities on denning bears are not well studied, but there is no evidence to indicate that current levels of motorized over-snow vehicle use are inhibiting the recovery of the grizzly bear population in the NCDE (R. Mace, MFWP, pers. comm. 2015). In the Draft Grizzly Bear Conservation Strategy (USFWS 2013), the USFWS stated that the available data about the potential for grizzly bear disturbance or den abandonment from nearby snowmobile use is extrapolated from studies examining the impacts of other human activities and is identified as “anecdotal” in nature (Swenson et al. 1997) with sample sizes so small they cannot be legitimately applied to assess population-level impacts (Harding and Nagy 1980, Reynolds et al. 1986; Hegg et al. 2010).There are no reports of den abandonment by grizzlies in the lower 48 States due to snowmobiling activity (Hegg et al. 2010; Servheen 2010). The USFWS (2013) concluded that current levels of snowmobile use are not appreciably reducing the survival or recovery of grizzly bears.

Mace assessed the distribution of 252 verified grizzly bear dens in the NCDE as of 2014 with respect to areas open to motorized over-snow vehicle use or closed to motorized over-snow vehicle use (see exhibit V-21)(figure 1-33 and 1-34, grizzly bear denning habitat). He found that 25% of the dens are in designated Wilderness (19% of the 25% are female grizzly bears), 15% of the dens are in Glacier National Park (13% of the 15% are female grizzly bears), 31% of the dens are in areas open to motorized over-snow vehicle use until April 1st (27% of the 31% are female grizzly bears), 5% of the dens are in areas open to motorized over-snow vehicle use after April 1(4% of the 5% are female grizzly bears), and 24% are in other areas closed to motorized over-snow vehicle use on the Forest (23% of the 24% are female grizzly bears)(R. Mace, MFWP unpublished data 2015). The percentage of den locations is proportional to the amount of modelled denning habitat in each category.

Areas open to motorized over-snow vehicle use on the Flathead National Forest have been limited by the winter use provisions of the Flathead’s Winter Motorized Recreation Plan Amendment 24 [USDA FS 2006]. This decision identified areas suitable and not suitable to motorized over-snow vehicle use, including four late-season (outside of grizzly bear denning season) areas within the primary conservation area (Canyon Creek, Challenge-Skyland, Lost Johnny, and Six Mile) where motorized over-snow vehicle use is allowable during April and May (the time period when female grizzly bears with cubs may be emerging from their dens) (USFWS 2006, appendix A).

Some members of the public expressed a concern about the effects of motorized over-snow vehicle use on grizzly bears during the den emergence time period. Bear research scientists and managers have suggested that in the period shortly before or after den emergence in the spring, a female with cubs may be particularly vulnerable to disturbance by people because cubs have limited mobility after den emergence and the females and their cubs have high energetic needs (Haroldsen et al. 2002, Mace and Waller 1997). However, such effects have never been documented and there are no known scientific papers supporting this potential impact.

Table 45 and table 46 show motorized over-snow vehicle use in the PCA according to season (denning season for grizzly bears and den emergence time period). During the denning season, about 24% of the primary conservation area on the Forest is suitable for motorized over-snow vehicle use. Late spring motorized over-snow vehicle use is suitable on about 3 percent of the acreage within the primary conservation area (see the Forest's over-snow vehicle use maps, and refer to figures 1-33 and 1-34). Note that miles and acres displayed in table 45 and table 46 reflect the A24 decision, but may be different due to realignment of data layers and GIS updates.

Table 44. Miles/acres suitable for motorized over-snow vehicle use within the primary conservation area during the grizzly bear denning season (Dec 1 to March 31)[1]

Area	Motorized Over-Snow Vehicle Routes	Motorized Over-snow Vehicle Areas
PCA	788 miles	513,654 acres

1 This includes all routes and areas open during this time period.

Table 45. Miles/acres suitable for motorized over-snow vehicle use within the primary conservation area during the non-denning season (April 1 to Nov 30)[2]

Area	Miles	Acres
PCA	666	57,178

1 This includes all routes and areas open during this time period.

The USFS and MFWP have monitored motorized over-snow use, as well as known den locations and bears emerging from their dens, and reported this information to the USFWS (planning record exhibit V-22). The agencies have not detected any conflicts due to over-snow use on the Flathead National Forest. The grizzly bear population has recovered with the level of over-snow use that has been occurring. The Draft Grizzly Bear Conservation Strategy stated that monitoring would continue to support adaptive management decisions about snowmobile use.

Some members of the public expressed a concern that changes in climate may cause grizzly bears to emerge from their dens earlier, increasing the potential for conflicts with motorized over-snow use. The draft Grizzly Bear Conservation Strategy established dates for the denning season. West of the continental divide on the Flathead National Forest, the denning season is defined as December 1-March 31. Mace collected data on known dens in the NCDE and on the Flathead National Forest through 2014. On the Flathead National Forest, den emergence dates ranged from 4/16-5/29, with the exception of one bear emerging on April 4 of one year, so April 1 is a conservative date for den emergence. In 2015, a year with lower than average snowfall overall, the earliest known bear emergence date on the Flathead National Forest was April 23 for males and April 28 for females (R. Mace pers. comm. 2015). Mace did not detect shifts in den emergence of the NCDE grizzly bear population associated with changes in climate (Mace and Roberts 2015).

Grizzly bear habitat and trail use

Table 47 shows the different types of allowable trail uses on the Forest by approximate miles and recreation type; trails can have multiple types of use on them so the miles displayed are overlapping, not additive.

Table 46. Allowed summer trail use on the Flathead National Forest in miles

Bicycle	Hiking	Pack and Saddle	Wheeled Motorized
806	2,053	2,012	226

Non-motorized uses have not been shown to affect grizzly bear population recovery thus far. A lack of demonstrable effects and the difficulty of accurately measuring human use on non-motorized trails led to the decision by the conservation strategy team to no longer count non-motorized uses as deducting from secure core percentages (USFWS 2013). Effects of non-motorized trails will not be discussed further.

Grizzly bear habitat and developed recreation sites

Developed recreation sites are sites or facilities on federal lands with features that are intended to accommodate public use and recreation. Examples include campgrounds, trailheads, rental cabins, fire lookouts, summer homes, and visitor centers. Developed recreation sites include those designed for over-night use and those designed for day use (see NCDE definition in glossary). Developed recreation sites can impact bears through temporary or permanent habitat loss and displacement, but the primary concern is grizzly bear-human conflicts caused by unsecured bear attractants, habituation, and food conditioning, which could lead to grizzly bear mortality or removal from the ecosystem (Knight, Blanchard and Eberhardt 1988). Grizzly bear-human conflicts have occurred at developed recreation sites on National Forest System lands, although efforts such as food storage orders, bear-resistant containers, and public education have been implemented to help reduce the risk of conflicts. Most of the grizzly bears killed or removed by management agencies in the NCDE in the past had been involved in conflicts related to unsecured attractants such as garbage, bird feeders, pet/livestock feed and human foods. Although the majority of these mortalities occurred on private lands, the risk of grizzly bear mortality at developed recreation sites on public lands in the primary conservation area remains of concern.

Developed recreation sites that support overnight public use have a higher potential to increase both the levels of bear attractants and grizzly bear mortality risk (USFWS 2013). The draft GBCS stated, “Developed sites are generally associated with frequent, overnight or prolonged human use that may increase both the levels of bear attractants and grizzly bear mortality risk. Developed sites can impact bears through temporary or permanent habitat loss and displacement, but the primary concern regarding developed sites is direct bear mortality or removal from the ecosystem due to bear/human conflicts caused by unsecured bear attractants, habituation, and food conditioning” (Mattson et al. 1987; (Knight, Blanchard, and Mattson 1988); Gunther et al. 2004; Servheen et al. 2004). The draft NCDE Grizzly Bear Strategy concluded that “securing potential attractants is the single most effective way to prevent bears from becoming food conditioned and displaying subsequent unacceptable aggressive behavior." (USFWS 2013). Food storage orders requiring proper storage of attractants are in place on all Forest lands.

While food storage orders are highly effective, the Draft Grizzly Bear Conservation Strategy includes measures to further reduce the risk of grizzly bear-human conflicts at overnight developed recreation sites by limiting increases in their number and capacity within the primary conservation area. Because the draft NCDE Grizzly Bear Strategy focuses on developed recreation sites with frequent, overnight or prolonged human use, the grizzly bear analysis also focuses on these sites (see the recreation section of chapter 3 in volume 2 for a discussion of all recreation sites on the Flathead National Forest).

On the Forest, there are 63 campgrounds, 63 recreation residences and 20 lookouts/cabins/lodges designed for overnight use on NFS lands in the PCA (see table 48 for the number of sites and table 49 for their capacity).

Table 47. Number of developed recreation sites designed for overnight use in the primary conservation area on the Flathead National Forest

	Number of Developed campgrounds	Number of cabins, lodges, lookouts with overnight use	Recreation Residences
PCA	63	20	63

Table 48. Capacity of developed recreation sites designed for overnight use in the primary conservation area on the Flathead National Forest

	Capacity of Developed campgrounds	Capacity of cabins, lodges, lookouts with overnight use	Capacity Recreation Residences
PCA	552	48	63

The Forest also has one developed resort on National Forest System Lands in the PCA, the Whitefish Mountain Resort, as well as an unknown number of dispersed recreations sites. Food storage orders are also effective at reducing the risk of grizzly-bear human conflicts at these sites.

Grizzly bear habitat and livestock allotments

While grizzly bears frequently coexist with large livestock such as adult cattle without preying on them, when grizzly bears encounter smaller animals such as calves, domestic sheep, goats, or chickens, they will often kill them (Jonkel 1980; Knight and Judd 1983; Orme and Williams 1986; Anderson et al. 2002). If repeated depredations occur, managers may relocate bears or remove them from the population (counted as a grizzly bear mortality). Because of the increased risk to grizzly bears posed by actions taken to protect sheep and other small livestock, the 1986 Interagency Grizzly Bear Guidelines emphasized the reduction of livestock allotments on public lands. Grizzly bear predation on small animals (especially chickens) continues to be a source of grizzly bear-human conflicts on private lands, but multiple agencies and non-government organizations (NGOs) are making concerted efforts to reduce this source of grizzly bear mortality.

As stated in the Draft Grizzly Bear Conservation Strategy, "Current levels of grazing on permitted livestock allotments in forested environments are not displacing grizzly bears in significant ways and are not likely to affect vegetation structure enough to result in direct competition for forage species on public lands within the NCDE, as evidenced by the increasing population trend in the NCDE" (USFWS 2013). As a result, the Draft Grizzly Bear Conservation Strategy included measures to keep livestock grazing at or below the baseline levels that occurred while the NCDE grizzly bear population has recovered.

On the Forest, there is no sheep grazing and very limited cattle grazing occurs. The Flathead National Forest currently has seven active cattle allotments –four in the Salish GA outside the PCA (recovery zone) and three in the Swan Valley GA inside the primary conservation area (recovery zone)(see figure 1-55 grazing allotments). Current allotment acreage represents approximately 3% of National Forest system lands, consisting of about 81,500 acres. Authorized grazing on the Flathead National Forest has declined over the last several decades. Current animal unit months (AUMs) authorized for grazing totals about 1078 (see grazing section in volume 2, chapter 3 for more details). Because livestock grazing has been declining, the risk of conflicts on the Forest has also declined.

There have been no known livestock-related grizzly bear mortalities on the Flathead National Forest. According to the draft GBCS, "impacts on grizzly bears due to attractants associated with livestock can be effectively minimized with requirements to securely store and/or promptly remove attractants associated with livestock operations (e.g., livestock carcasses, livestock feed, etc.)". Livestock carcasses are promptly removed and livestock feed is properly stored on Forest lands, as required by the food storage orders that are in place.

There are permitted grazing operations on National Forest System land for horses and mules in the NCDE, primarily associated with outfitter and guide operations or Forest Service administrative use. The Food Storage Order addresses attractants associated with horses or mules and there is no evidence of conflicts with bears due to depredation, attractants, or forage competition related to horse and mule grazing permits. Honeybees, classified as livestock in Montana (MCA 15-24-921), can be attractants to some grizzly bears. There are no permitted honeybee operations on the Forest.

Grizzly bear habitat and vegetation management

Timber harvest, wildfire, prescribed fire and other vegetation management activities may alter the amount and arrangement of cover and forage. The Interagency Grizzly Bear Guidelines addressed vegetation management activities and these guidelines were incorporated into the 1986 Flathead Forest plan, guiding management for the last 30 years. The Draft Grizzly Bear Conservation Strategy (USFWS 2013) includes similar strategies for vegetation management that are designed to increase grizzly bear foods and protect seasonally important habitats. In accordance with the 2012 planning rule directives, these strategies are incorporated in appendix C of the revised forest plan.

Grizzlies in the NCDE occupy numerous types of habitat, including those with forest cover and those without (Aune and Kasworm 1989, Waller and Mace 1997). Vegetation management can increase the quantity and quality of grizzly bear foods through increased growth of grasses, forbs and berry-producing shrubs (Zager et al. 1983; Kerns et al. 2004) but can also increase mortality risk if roads remain open. In the early 1980s, there were few road closures on the Forest, but by the late 1990's, many roads on NFS lands had been closed and many road closures continued to be implemented in the first decade since 2000.

In the dense forests of the Forest, thick growth of conifers provides high levels of cover, but may reduce the availability of some bear foods. Mace and Waller (1997) studied grizzly bear habitat use in the Swan Mountain Range of the Forest and found that the highest grizzly bear densities obtained over time were in those locations with ≤ 40% overstory tree canopy. They stated that vegetal foods used by grizzly bears (grasses, forbs and shrubs) were more common in open to open timbered habitats and that available foods in timber harvest units were used by grizzly bears provided there was restriction of vehicular traffic. They found that grizzlies were more likely to use cutting units harvested 30-40 years ago than older or newer cutting units and that these were the most preferred habitats during summer (Mace and Waller (1997). Mace and Waller reported that grizzly bears avoided lower elevation, more accessible harvested areas as well as areas less than 30–40 years following regeneration harvest where cover was not available.

In a recent Alberta study, Stewart and others assessed habitat selection near edges created by human activities as well as natural edges, based upon GPS telemetry data from 26 grizzly bears. These authors found that there was no selection of edges associated with human activities in the spring, but they found that both male and female grizzly bears selected for edges associated with human activities (roads and timber harvest) in summer and fall and were not displaced. They attributed this selection to increased food resources at transitions between harvested areas dominated by shrubs, and conifer stands providing cover. Their study area has high levels of timber harvest as well as oil and gas exploration, with forest harvest edge accounting for about 52% of all edges. While they did not observed displacement, they cautioned that use of edges created by humans can result in higher mortality risk to grizzly bears. Therefore, they recommended limiting access to habitat that is heavily selected by bears during the fall ungulate hunting season, when human use is extensive and grizzly bear mortality from human self-defense or illegal kills is highest (Stewart et al. 2013).

Mace and others (1999) also described the seasonal relationship between vegetation, human activity, and habitat use by female grizzly bears, considering all land ownerships, in their Swan study area. During spring, female grizzly bears used low-elevation habitats, where winter snow melted first and succulent vegetation favored by bears appeared. These lower-elevation habitats also contained most of the human activities and roads, so reductions in habitat use from potential were highest during spring. Areas with a high density of high traffic-volume roads were strongly avoided, and no bears were observed near high-impact human activity points. These authors suggested that there is value in road closures aimed at minimizing traffic on roads within important seasonal habitats (Mace et a. 1999).

Ruby (2014) studied grizzly bear habitat use along Montana Highway 83 in the Swan Valley and found that grizzly bears exhibited little negative selection for high open road densities within the Swan Valley study area. The study area has forest roads and residences relatively well distributed throughout the valley bottom intermixed with quality bear habitat (Servheen and Sandstrom 1996). Ruby (2014) used location data from 24 grizzly bears instrumented with GPS collars using the Swan Valley of the Forest from 2000 to 2011 to characterize grizzly bear movement and habitat-use patterns. Use of GPS collars enabled grizzly bears to be tracked on a 24-hour basis. Ruby found that grizzly bears use high-quality habitats around human development and are not completely displaced. Rather, bears adopted movement patterns in close proximity to open roads and homes so that they were active during night time-periods when human activity was lowest. While human activity associated with human site development in the rural landscape of the Swan Valley did not affect habitat selection, Ruby noted that it can result in human encounters resulting in grizzly bear mortality or management-related removals from the population (Delibes et al. 2001, Neilson et al. 2004, Schwartz et al. 2010)(Mattson et al. 1990). Where resources are not limiting, grizzly bear movement patterns that avoid periods of human activity may be an important strategy for limiting mortality risk to grizzly bears.

Grizzly bear habitat and leasable, locatable, and salable mineral activities

Mineral and oil and gas development have the potential to increase grizzly bear mortality risk from associated motorized use, habituation, and/or increased grizzly bear-human encounters and conflicts. Permanent habitat loss, habitat fragmentation, and displacement from habitat may also occur.

There are three general types of mineral resources associated with national forests: leasable minerals, locatable minerals, and salable mineral materials. Locatable mineral development refers to surface and underground hardrock mining of metallic minerals and nonmetallic minerals. Salable minerals include materials such as common varieties of sand, stone, and gravel. Leasable mineral development includes the production of materials such as oil and natural gas (see the section of the revised forest plan and DEIS chapter 3 on Energy and Minerals for more details).

The Forest Service has management authority over the surface resource impacts resulting from locatable mineral activity, and has full discretionary authority over disposal of salable mineral material. For leasable commodities on lands managed by the Forest Service, the Bureau of Land Management issues all leases. Mineral development refers to surface and underground hardrock mining and coal production, which is regulated by permits on National Forest System lands.

In the NCDE primary conservation area, there are no Plans of Operation or Notices of Intent to explore or operate any commercial mines on National Forest System or Bureau of Land Management lands, except for one mine on the Helena National Forest. The production of oil and natural gas is conducted through a leasing process. Forest Plan standards and guidelines provide guidance for authorizations and stipulations that are determined at the project level.

On the Forest, approximately 62 percent of NFS lands are withdrawn from mineral entry. All withdrawals are subject to valid existing rights. The type of lands withdrawn from mineral entry and leasing in the Flathead National Forest plan area include:

- administrative sites, such as campgrounds;
- forest lands within the boundaries of a ski area permit;
- The Bob Marshall, Great Bear, and Mission Mountains Wilderness areas; and
- sections of the North, South and Middle Forks of the Flathead River (see figure B-53).

The Flathead National Forest Assessment (2014) described existing uses and trends for minerals and provided known information on the potential for future development. The Forest has low potential for leasable and locatable minerals. For the Flathead National Forest, extraction of landscape rock and gravel for road surfacing has been the predominant minerals use in recent years (see Flathead National Forest Assessment Part 2, 2014 for more details).

Grizzly bear habitat and connectivity

Habitat connectivity can affect grizzly bears at multiple scales; between grizzly bear ecosystems, within ecosystems, and within a home range. For a discussion of habitat connectivity within the NCDE as a whole, as well as between the NCDE and the Bitterroot or Greater Yellowstone Ecosystems, see Volume 3. The following section addresses habitat connectivity between the Forest and the Cabinet-Yaak Ecosystem, at the scale of the Flathead National Forest as a whole and within subunits representing a female home range.

Grizzly bear habitat connectivity has been modelled and mapped using a variety of methods. One indicator of habitat connectivity is the pattern of security core across the Flathead National Forest portion of the PCA and within subunits representing female home ranges. On NFS lands, security core levels are high and security habitat is connected in most places within the Forest's recovery zone/primary conservation area, allowing bears to move across the landscape (see figures 1-33 and 1-34).

Effects to habitat connectivity also occur with respect to "habitat permeability" and the "developed human footprint" including communities, highways, land converted to agriculture, and other factors. For grizzly bears, areas of low permeability (higher levels of permanent human development) may be associated with avoidance during certain seasons or times of day or higher grizzly bear mortality due to conflicts with humans. In the area occupied by grizzly bears on the Flathead National Forest, grizzlies generally avoid the "developed human footprint" in and around Kalispell, but bears may be drawn to residences in smaller rural communities and valley bottoms if attractants are present (also see grizzly bear cumulative effects section of volume 3).

The Nature Conservancy mapped landscape permeability for the Pacific Northwest (McRae et al. 2015)(see planning record exhibit V-23). Proctor (2015) and Weaver (2013) modelled and mapped preferred "linkage habitats" for grizzly bears along highways within the Flathead National Forest and adjacent areas (including Canada) in order to inform management of connectivity. Their models and maps were based upon resource selection functions that indicate relative habitat importance.

Waller and Servheen studied grizzly bear habitat connectivity along the Highway 2 corridor between Glacier National Park and the Flathead National Forest, evaluating trans-highway movements of 42 grizzly bears and relating them to highway and railroad traffic volumes as well as other corridor attributes (Waller and Servheen 2005). They found that grizzly bears strongly avoided areas within 0.31 miles of the highway and that highway crossing frequency was negatively related to highway traffic volume. Most highway crossings occurred at night when highway traffic volume was lowest, but when railroad traffic was highest (Waller and Servheen 2005). Waller and Miller also found that traffic volumes increased when they compared the 1999-2001 study periods and the 2012-2013 periods (Waller and Miller 2015]. Traffic volume increases were most dramatic during the hours in which grizzly bears were most likely to cross the highway, thus suitable crossing opportunities have declined.

Northrup and others studied grizzly bear response to traffic levels on the entire road network in southwestern Alberta. They found that traffic patterns caused a behavioral shift in grizzly bears, with increased use of areas near roads and movement across roads during the night when traffic was low. Bears selected areas near roads travelled by fewer than 20 vehicles per day and were more likely to cross these roads. Bears avoided roads receiving moderate traffic (20–100 vehicles per day) and strongly avoided high-use roads (>100 vehicles per day) at all times (Northrup et al. 2012).

Despite higher levels of mortality along some of the transportation corridors and associated human developments within the Forest, the grizzly population continues to grow and expand (Costello et al. 2016, in press).

The previous affected environment section describes key ecosystem characteristics. The key stressors section which follows provides a foundation for the alternative effects analysis and an understanding of which stressors the USFS has authority to manage. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are activities that might impact a species and its habitat if not managed or mitigated. Stressors that are outside of Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. For the grizzly bear, these are considered under the cumulative effects section of volume 3.

Key stressors under USFS control

Land Management: As described above, the USFS can control road management, vegetation management, livestock grazing, developed recreation sites, and minerals only on lands over which it has authority.

Key stressors not under USFS control

Mortality due to grizzly-human conflicts in Canada: The Forest has a boundary along the Canadian border and grizzly bears use the area along this boundary (Mace and Roberts 2012). In Canada, the main human activities that have the potential to impact grizzly bears and their habitat along a portion of the border are timber harvesting, oil and gas exploration and development, coal mining, and associated access and other human development. In the British Columbia portion of the North Fork Flathead River watershed (adjacent to the Forest), the Flathead Watershed Area Conservation Act permanently prohibits coal mining as well as exploration and development of oil, gas and mineral resources on almost 400,000 acres, protecting grizzly bear habitat.

Mortality on private lands: (1990)The USFS does not have authority to manage grizzly bear-human conflicts or human-caused mortality on private lands. Population monitoring and management of human-grizzly bear conflicts is under the authority of Montana Fish, Wildlife and Parks (MFWP). MFWP has several bear management specialists in the NCDE, including one who manages bear conflicts on the Forest, who work with and educate the public to reduce mortality.

Mortality due to hunting of grizzly bears: Legal hunting of grizzly bears has not occurred in Montana since 1991 (Pac and Dood 1998), but it has occurred in Canada. In Montana, grizzly bears are occasionally killed by poachers, are mistakenly killed during the black bear hunting season, and are killed in self-defense (Costello et. al 2016, in press). As a result, Montana instituted a mandatory black bear hunter testing and certification program to help educate hunters in distinguishing species and reducing mistaken identity, and therefore, reducing grizzly bear mortalities. Management by MFWP may include regulated hunting in the future, once the NCDE grizzly population is delisted. Should hunting be part of grizzly bear management, there are currently no known factors that would limit harvest on the Forest. Montana FWP would monitor mortality due to hunting and its effects on the NCDE grizzly bear population.

Climate change: The USFWS examined climate change and potential effects on the grizzly bear in its 5-Year Review: Summary and Evaluation (USFWS 2011). According to the review, the most likely ways in which climate change may affect grizzly bear habitat include: reduction in snowpack levels; shifts in denning times; shifts in the abundance and distribution of some natural food sources; and changes in fire regimes due to summer drought. “While the extent and rate to which individual plant species will be impacted is difficult to foresee with any level of confidence (Fagre, Peterson, and Hessl 2003, Walther et al. 2002), there is general consensus that grizzly bears are flexible enough in their dietary needs that they will not be impacted directly by ecological constraints (Servheen and Cross 2010).” As stated in the draft Grizzly Bear Conservation Strategy (USFWS 2013), “most grizzly bear biologists in the U.S. and Canada do not expect habitat changes predicted under climate change scenarios to directly threaten grizzly bears (Servheen and Cross 2010). These changes may even make habitat more suitable and food sources more abundant. However, these ecological changes may also affect the timing and frequency of grizzly bear/human interactions and conflicts (Servheen and Cross 2010).”

Key indicators for analysis

The indicators used to describe and disclose indirect effects of alternatives are summarized in table 50, with details provided in each section. Indicators are based upon key stressors, public comments, and issues identified during scoping. Potential stressors to grizzly bear populations which the USFS cannot control, but which are considered for cumulative effects, are addressed in volume 3.

Table 49. Overview of grizzly bear indicators used to assess effects of alternatives

Resource Element	Resource Indicator
Grizzly bear habitat security	How plan components affect open and total motorized routes and secure core/security core habitat for grizzly bears How plan components affect areas open to motorized over-snow vehicle use How plan components affect high-use non-motorized trails
Developed recreation	How plan components affect the risk of grizzly bear-human conflicts at developed recreation sites during non-denning season
Grazing allotments	How plan components reduce the risk of grizzly bear-human conflicts due to livestock grazing
Vegetation management	MA categories and effects of vegetation management and fire on habitat, potential for human disturbance/displacement, biodiversity.
Minerals management	How plan components lower the risk of loss of habitat, displacement, road mortality, grizzly-human conflicts due to energy and mineral development.
Habitat connectivity	How plan components address grizzly habitat connectivity on all lands within the Flahtead NF GAs.
Demographic connectivity	How plan components support female grizzly bear occupancy in the Salish DCA.
Grizzly bear-human conflicts	How plan components reduce the risk of grizzly bear-human conflicts.

Environmental consequences common to all alternatives

Grizzly bear-human conflicts

All alternatives include plan components for food storage orders, which are in effect across the Forest to reduce the risk of grizzly-bear human conflicts.

Grizzly bear habitat security

Wilderness

Congressionally-designated wilderness comprises about 50 percent (1,075,376 million acres) of the Flathead National Forest primary conservation area (figure B-01). Designated wilderness areas would continue to provide high levels of habitat for grizzly bears under all alternatives.

Inventoried Roadless Areas

Inventoried roadless areas are the same for all alternatives and provide a high level of grizzly bear habitat security, where temporary disturbance due to projects is highly unlikely (see figure B-02 for distribution of inventoried roadless areas).

Alternatives vary with respect to management area (MA) designation of inventoried roadless areas, as discussed below, but none of the alternatives can conflict with the Roadless Area Conservation Rule (36 USDA 294). This rule established prohibitions on road construction, road reconstruction, and timber harvesting within inventoried roadless areas on NFS lands. Responsible officials do not have the authority to recommend additional designated roadless areas or to modify the boundaries of designated roadless areas covered by the Roadless Area Conservation Rule.

Most of the inventoried roadless areas on the Forest are in the PCA, but a small percentage also occur in the Salish DCA (table 43)(see figure B-02).

Figure 38. Inventoried roadless areas (IRAs) by NCDE management zones

NCDE Management Zone	IRAs on NFS lands acres (percent)
Primary Conservation Area	473,290 (99%)
Salish DCA, Zone 1	5,465 (1%)
Zone 1, outside DCA	2 (<1%)
Outside NCDE Management Zone	<1 (<1%)

With all alternatives, there would be at least 78% of modelled grizzly bear denning habitat where motorized over-snow vehicle use would not be suitable (see the Forest's over-snow vehicle use maps and refer to figures 1-33 and 1-34), thus minimizing the risk of harassment or disruption of grizzly bear denning. Suitability for motorized over-snow use varies by alternative, as discussed below.

Minerals and Energy

All National Forest System lands are available for the staking of claims for locatable minerals under the general mining law, unless withdrawn from mineral entry by an act of Congress or through the withdrawal process under the Federal Lands Policy and Management Act. As stated in the affected environment section, portions of the Forest (such as wilderness) are withdrawn from mining and mineral leasing laws or have "no surface occupancy" stipulations, subject to valid and existing rights. The North Fork Watershed Protection Act of 2013 withdrew portions of the Forest from mineral development (see minerals and energy section of chapter 3 for more details) (see figure B-53). Withdrawal of these large areas reduces the risk of grizzly bear habitat loss, disturbance, displacement, and mortality under all alternatives. Minerals stipulations vary by alternative. Some of the current oil and gas leases are suspended (see figure 1-34, suspended oil and gas leases) because the *Conner v. Burford* decision requires the Forest Service to complete an oil and gas leasing EIS prior to the leases being activated. There are no plans or funding to pursue an oil and gas leasing EIS on the Flathead National forest, so any possible affects would be highly speculative and uncertain. No activity can take place on the leases until an EIS is completed. A leasing decision will not be a part of this Forest Plan Revision.

Environmental consequences alternative A

With alternative A, management would continue to support NCDE grizzly bear population recovery, but it would not provide the regulatory framework needed for de-listing. Under the no-action alternative, grizzly bear management situations and guidelines applicable to each would continue to be implemented.

Consequences of motorized access management direction for the no-action alternative A

Habitat security within the grizzly bear recovery area (PCA)

Under the no-action alternative, the Forest would continue to implement amendment 19. With plan components under alternative A, there would be an expectation that additional roads and trails would be closed to motorized use, reclaimed and/or decommissioned. The Forest would close roads in nine grizzly bear subunits originally included in amendment 19, in order to provide at least 68 percent security core (table 51, see figure 1-36, subunits with additional road closures), unless site-specifically amended (see section 3.11.4 of volume 2, tables 23 and 24 for more details).

Table 50. Estimated miles of NFS road closures to meet core standard or amended standard in 9 subunits where NFS had greater than or equal to 75% of the subunit acreage when amendment 19 was enacted.

Grizzly bear subunit name	~Miles of road/wheeled motorized trails to close
Hay Creek	11 miles roads
Canyon McGinnis	2 miles roads
Peters Ridge	27 miles wheeled motorized trails and 10 miles roads
Swan Lake	19 miles wheeled motorized trails and 9 miles roads
Crane Mountain	33 miles roads
Beaver Creek	13 miles roads
Emery Firefighter	9 miles roads
Logan Dry Park	19 miles roads
Skyland Challenge	1 mile wheeled motorized trails and 4 miles roads

In addition to the subunits listed above, seven subunits where the Forest now manages at least 75% of the land acreage, would have additional road closures, as explained in the affected environment section. Table 52 displays these subunits and the estimated miles of road that would need to be closed to meet 68% security core, unless site-specifically amended.

Table 51. Estimated miles of road that would be closed if 68% core is to be met in the seven subunits where NFS lands are now greater than or equal to 75% of the subunit acreage.

Grizzly bear subunit name	~Miles of road to close
Buck Holland	40 miles road
Cold Jim	68 miles road
Glacier Loon	56 miles road
Hemlock Elk	25 miles road
Lion	36 miles road
Meadow Smith	58 miles road
Piper Creek	43 miles road

In order to fully meet amendment 19 (OMAD, TMAD and security core), a total of approximately 518 miles of roads would need to be reclaimed, and either on the transportation system as impassable or off the transportation system as decommissioned (including up to about 400 miles of roads on lands acquired through the Legacy project), and 57 miles of trails would no longer allow wheeled motorized, unless site-specifically amended. This figure is an estimated programmatic assessment of the number of miles needed to meet amendment 19. The actual number may be higher or lower depending upon changing access conditions on adjacent lands and the site-specific factors that must be considered when evaluating access and grizzly bear habitat needs. Amendment 19 does not apply to portions of the Salish Geographic Area west of Highway 93; therefore motorized use of roads and trails would not be reduced there for grizzly bear security. The Forest would continue to make progress toward implementation of amendment 19 management direction as funding allows. In addition, wilderness and recommended wilderness would provide high levels of habitat security (see figure 1-37, grizzly bear security core for alternative A).

This alternative would provide very low risk of individual female grizzly bear displacement on NFS lands, because wheeled motorized trails, high-use non-motorized trails, and gated or open roads in the grizzly bear recovery area/primary conservation area would be further restricted. It is uncertain whether additional road or trail restrictions on NFS lands would reduce female mortality or increase the grizzly bear population, because grizzly bears are a wide ranging species and grizzly bear mortality may still occur on private lands.

Habitat Security Outside the grizzly bear recovery area/PCA: Although no management direction specific to grizzly bears is given in the 1986 Flathead Forest Plan, the forest plan contains management direction that provides benefits to grizzly bears through standards or guidelines pertaining to other species and their habitats, such as elk. Selected recommendations from the Elk Logging Study (1986 Forest Plan Appendix DD) would continue to be followed. This direction has an indirect effect of providing seasonal security for grizzly bears and protecting moist sites in the Salish Geographic Area. In addition, requirements of any biological opinion provided by the USFWS while the grizzly bear is listed would be followed.

The 1986 Plan adopted maximum linear road densities which apply to smaller geographic units in the Salish GA, as displayed in table 53. However, as grizzly bears began to occupy the Salish Mountains GA, subsequent ESA Section 7 consultation provided direction for management of NFS lands to reduce grizzly bear mortality risk. The USFWS issued biological opinions, incidental take statements, as well as Terms and Conditions for the Salish Mountains GA, focusing on access management, livestock grazing, and food/attractant storage that would occur with continued implementation of the Flathead National Forest plan (USDA FS 2005, USDI FWS 2006, USFWS 2011, USFWS 2012). Table 53 shows the maximum density of roads open to public use in each geographic unit as well as the baseline density of roads open to public use that now occurs as a result of road closures to provide elk security and meet Terms and Conditions for grizzly bears.

Table 52. Maximum density of roads open to the public yearlong by geographic unit

Geographic Unit	Maximum density requirement (average linear miles/section of NFS lands[1])	Baseline density(avg. linear miles/section of NFS lands[1])
Swan Lake Ranger District		
Island Geographic Unit	2.2	1.7
Tally Lake Ranger District		
Olney-Martin Creek Geographic Unit	1.8	1.6
Upper Good Creek Geographic Unit	1.8	1.2
Sylvia Lake Geographic Unit	1.8	1.3
Star Meadow-Logan Creek Geographic Unit	2.2	1.6
Tally Lake-Round Meadow Geographic Unit	2.2	1.7
Mountain Meadow-Rhodes Draw Geographic Unit	2.2	1.7
Upper Griffin Geographic Unit	3.2	0.9
Ashley Lake Geographic Unit	3.2	1.8

1-the USFS does not have authority over lands that are not in the National Forest System (NFS lands)

Outside the primary conservation area in zone 1, the effects of linear open road densities are compared to the findings of Boulanger and Stenhouse (2014) (see planning record exhibit V-14). These authors found that grizzly bear occupancy of habitat occurred where linear open road densities did not exceed 2.4 miles per square mile. All geographic units in Zone 1 are less than this limit, supporting grizzly bear occupancy on NFS lands.

With respect to female grizzly bears, the USFWS determined that high road densities and lack of secure core would have impacts on individual bears in some areas outside the recovery zone, but that current management supports occupancy by female bears (USFWS 2011, USFWS 2012).

Consequences of management direction for motorized over-snow vehicle use: the no-action alternative A

The Forest would continue to implement amendment 24 (USFS 2006) restricting motorized over-snow recreation use in the recovery zone/primary conservation area during the grizzly bear den emergence time period. Motorized over-snow vehicle use during the den emergence time period would be allowed on yearlong open roads when snow conditions permit, but would otherwise be limited to 4 “play areas” (Canyon Creek, Challenge-Skyland, Lost Johnny, and Six Mile) and 11 groomed routes within the PCA (see winter recreation section of chapter 3, figure 1-43, and refer to the Forest’s current over-snow vehicle use map).

Less than 22 percent of modeled grizzly bear denning habitat on the Flathead National Forest overlaps with the areas open for motorized over-snow use during the late season. Given that numbers of snowmobilers declines by April of each year, the probability of a snowmobile encountering a female with cubs using a particular area of denning habitat is low. The USFWS wrote in their 5-year review for grizzly bear (USFWS 2011), “Our best information suggests that current levels of snowmobile use are not appreciably reducing the survival or recovery of grizzly bears.” The NCDE population has been increasing and is likely headed towards delisting, so current levels of over-snow motorized use does not appear to be preventing the population from recovering”.

In summary, the risk of disturbance to females with cubs is small because; 1) a relatively small acreage of grizzly bear denning habitat is affected, 2) snowmobile use has been monitored by the USFS and grizzly bears emerging from their dens have been monitored by MFWP and there have not been any demonstrated effects to grizzly bears on the Forest (exhibit X in the planning record), 3) the grizzly bear population has recovered with existing areas open to motorized over-snow vehicle use during the den emergence time period.

As of 2015, there has been one known occurrence of a grizzly bear denning outside the recovery zone/ primary conservation area. The majority of modelled denning habitat occurs in the primary conservation area, so effects of activities during the den emergence time period are expected to be minor. Outside the primary conservation area in Zone 1, there are fewer restrictions on groomed snowmobile routes and snowmobile play areas during the den emergence time period. In addition, there is modelled denning habitat in the portion of the Salish GA near the Blacktail Mountain Ski Area west of Kalispell, but it is highly unlikely that grizzly bears would den in area due to high levels of winter recreation use that occurs there. Zone 1 has only about 400 acres of modelled denning habitat that is not in the Blacktail Mountain Ski Area (a very minor amount). Because this area of modelled denning habitat is heavily timbered and not accessible by road or trail, it is unlikely to get motorized over-snow use during the den emergence time period, so any potential effects of are expected to be minor.

Consequences of management direction for developed recreation sites: the no-action alternative A

Under the no-action alternative, the forest would continue to follow the IGBC recreation management guidelines in MS-1 and MS-2 grizzly bear habitat. While there is a potential for developed recreation sites to affect grizzly bears through habituation or food conditioning, the likelihood is low because food storage orders are in place across the Forest, greatly reducing grizzly-bear human conflicts on NFS lands across the Forest.

In addition, there is likely to be very little increase in the risk of grizzly bear-human conflicts at developed recreation sites on the Forest because 1986 Forest Plan management direction, and anticipated budgets limit increases in developed recreation sites on the Forest. The 1986 Flathead National Forest plan has a forestwide standard to retain the existing capacity of national forest developed recreation sites and to improve the quality of the developed recreation opportunities through "full-service" maintenance or redesign and reconstruction of existing sites, to better accommodate present and future needs as funding allows. Some slight capacity increases may occur as a result of these improvements. In the past decade, USFWS consultationsfor campground and cabin rental projects in the recovery zone/PCA have maintained the baseline for overnight developed recreation site capacity in a BMU in order to reduce the risk of grizzly-bear human conflicts while the grizzly bear population was recovering.

Consequences of management direction for grazing allotments: the no-action alternative A

There are no sheep grazing allotments on the Flathead National Forest. Based on the lack of history of conflicts, the mortality risk associated with cattle grazing is low and is expected to continue to be low under the No-action Alternative. Over the past several years, more than half of the Forest's 20 allotments were vacated and closed. In 2010, the Flathead National Forest administratively closed five vacant range allotments where use had not occurred for several years (see Livestock Grazing section of Chapter 3 for more details). Protections and mitigations to reduce livestock-grizzly bear conflicts include: 1) deferring livestock grazing in important spring habitat until after July 1, and 2) including permit measures to protect vitally important food sources from conflicting and competing uses by livestock. Existing cattle grazing allotments have been compatible with a recovered grizzly bear population.

Consequences of management direction for vegetation: the no-action alternative A

Under the no-action alternative, the forest would continue to follow the IGBC vegetation management guidelines in MS-1 and MS-2 grizzly bear habitat in the primary conservation area, as incorporated in the 1986 Forest Plan. These guidelines specify that measures to be taken to protect, maintain, and/or improve grizzly bear habitat and populations will be specified in project design. Inside and outside the PCA, the Forest would continue to consult with the USFWS on projects while the grizzly bear is listed.

Vegetation management direction would provide for diverse cover and forage conditions that support grizzly bears and would reduce the potential for grizzly bear displacement through timing of timber sale activities. Management direction for cover would result in smaller timber harvest openings and more fragmented habitat than would have occurred historically due to large fires, especially in the wildland-urban interface. Outside the wildland-urban interface, management direction in Canada lynx habitat would promote dense cover. However, larger wildfires as well as more insect and disease infestation are more likely in the future due to warmer, drier summer climate conditions. Wildfires, insect/disease infestation, and use of prescribed fire would reduce cover but promote grizzly bear foods, as would timber harvest. The SIMPPLLE and SPECTRUM models were used to estimate the differences in alternatives with respect to timber harvest and prescribed fire (see Vegetation section 3.3 for more details).

The existing forest plan and the programmatic biological opinion did not specifically provide for temporary decreases in secure core and/or temporary increases in total and open motorized route density in the primary conservation area. However, through project-level section 7 consultations in the NCDE, temporary changes have been allowed to accommodate projects such as post-fire salvage, timber harvest, and road management projects. The grizzly bear population has recovered during the time period when these temporary changes occurred.

Consequences of management direction for minerals: the no-action alternative A

The 1986 Flathead National Forest plan, as amended, contains management direction to mitigate effects of mineral development. This direction includes standards and guidelines associated with INFISH and grizzly bear guidelines for minerals and special uses applicable to all management situations (pg. II-42) in the recovery zone/primary conservation area. These mitigation measures reduce the impacts of mineral activities upon grizzly bears by: 1) reducing or eliminating impacts of mineral activities within riparian habitat conservation areas, 2) scheduling activities so as to provide grizzly bear security immediately adjacent to activity areas, 3) requiring restrictions on food storage, garbage disposal, firearms, and domestic pets at approved camps, 4) avoiding adverse effects that reduce habitat effectiveness in seasonally important habitats, and 5) restricting helicopter flight patterns. The forest has not had to apply this management direction because it has not had activities and there is a very low probability of any effects to grizzly bears in the future.

<u>Leasable mineral activity (e.g. oil and gas)</u>: The current Forest Plan says on page II-55: “Stipulations which are displayed in Appendix O and which are based on the Environmental Assessment of Oil and Gas Leasing of Non-wilderness Lands on Flathead National Forest, 1980, will be recommended in accordance with the management area direction in Chapter III. Before action is recommended on any lease application, additional site specific analysis of environmental affects will be done”. Each lease, if issued, would include numerous standard and special stipulations to minimize effects of oil and gas activities on surface resources.

Further the plan states: “The dominant mineral activity on the Forest is oil and gas leasing. Over 1,000,000 acres were leased or under lease application in 1984. A Federal court ruling in 1985 caused the BLM to suspend those leases until litigation is completed”. Some of the current oil and gas leases are suspended because the *Conner v. Burford* decision requires the Forest Service to complete an oil and gas leasing EIS prior to the leases being activated. There are no plans or funding to pursue an oil and gas leasing EIS on the Flathead National forest, so any possible affects would be highly speculative and uncertain. No activity can take place on the leases until an EIS is completed. A leasing decision will not be a part of this Forest Plan Revision.

Consequences of management direction for habitat connectivity: the no-action alternative A

Alternative A does not specifically address connectivity with respect to grizzly bears, but alternative A has Standard ALLS1 to provide connectivity for Canada lynx, which would also benefit grizzly bears. Inside the PCA, the 1986 Flathead Forest plan, as amended, provides for habitat connectivity during the non-denning season both in terms of cover and in terms of areas with low levels of human disturbance. Amendment 19 provides for low levels of human disturbance by specifying maximum densities of open and total roads and minimum amounts of security core for each grizzly bear subunit and 2) forestwide management direction associated with amendment 21, as well as INFISH, addresses cover to provide connectivity in old growth and riparian areas, which would benefit grizzly bears.

Consequences of management direction for demographic connectivity: the no-action alternative A

Demographic connectivity considers the genetic interchange between the Forest portion of the NCDE and the Cabinet-Yaak Ecosystem for grizzly bears (CYE). The 1986 Flathead National Forest Plan does not provide specific management direction to provide for female grizzly bear occupancy in the area outside the PCA (recovery zone) and does not address genetic interchange with the Cabinet-Yaak Ecosystem (CYE). In the last decade, MFWP has translocated grizzly bears from the NCDE to the CYE in order to facilitate genetic interchange. In recent years the number of documented grizzly bear reports in the area outside the recovery zone has been increasing as the population in the NCDE increases. More grizzly bears are exploring new territory further to the west (Mace and Roberts 2012).

Environmental consequences alternatives B, C, and D

All alternatives would provide the regulatory framework for grizzly bear de-listing.

Consequences of access management direction for the action alternatives B, C, D

All of the alternatives would maintain baseline levels of OMAD, TMAD and secure core in the primary conservation area, providing levels of security for grizzly bears that have supported grizzly bear recovery (displayed in table 54 below, table 42, and table 43), but alternative C would go further, as describe below. Inside the PCA, wheeled motorized trails would not increase because baseline levels of motorized access must be maintained.

Table 53. Public open motorized access for all roads/trails on NFS lands (includes highways, county/city & private roads/trails)

NCDE Management Zone	Open Road (miles)	Motorized Trail (miles)	Total Miles	NFS sq. miles	Miles/sq. mi. public open motorized roads and trails
Zone 1, Salish DCA	226	14	240	150	1.60
Zone 1, outside DCA	337	81	418	212	1.97

Outside the PCA, all action alternatives would maintain the baseline linear road density that has supported an expanding grizzly bear population (table 54). With alternatives B and D, baseline densities of wheeled motorized trails may increase in Zone 1, which may cause grizzly bear disturbance or displacment.

Differences in the action alternatives occur with respect to management direction for areas suitable for motorized over-snow vehicle use (figures B-03 to 05), wheeled motorized trails, and management direction for recommended wilderness (MA1b)(see figures 1-39 to 42, grizzly bear secure core and recommended wilderness by alternative A, B, and C).

Consequences of motorized access management direction specific to alternative C

Inside the grizzly bear recovery area/PCA

Alternative C would provide the lowest risk of grizzly bear disturbance/displacement (including females with cubs during the den emergence time period) because this alternative has the largest amount of recommended wilderness with the greatest restriction on motorized uses. With alternative C, wheeled motorized trail use, and motorized over-snow vehicle use would not be authorized in areas of Recommended Wilderness, so risks to individual grizzly bears would decrease in the future as site-specific decisions to close recommended wilderness areas to motorized use and mechanized transport are implemented (see figure 1-03)(see recreation section of chapter 3, volume 2 for more details). There is no scientific evidence that mechanized transport (e.g. mountain bikes) disturbs or displaces grizzly bears any more than hiking does, but mechanized transport would be restricted to the greatest degree with alternative C. In addition, alternative C is more restrictive of motorized use in grizzly bear core than the other action alternatives, because standard FW-STD-IFS-04 states that roads within secure core shall not be opened for temporary motorized use by the public, e.g. firewood cutting.

Outside the grizzly bear recovery zone/PCA in zone 1, including the Salish DCA

In addition to restrictions on motorized roads, alternative C also limits wheeled motorized trails on NFS lands in the Salish Demographic Connectivity Area to baseline densities. Including both roads and trails open to public motorized use, the baseline meets the density needed to support female grizzly bear occupancy in the Salish DCA and is consistent with maximum densities for females (Boulanger and Stenhouse 2014). These baseline densities have supported a recovered grizzly bear population. Baseline densities of wheeled motorized trails may increase in the rest of zone 1, which may cause grizzly bear disturbance or displacment.

Consequences of motorized over-snow access management direction specific to action alternatives B and D

Figures 1-33 and 1-34 display areas of modelled grizzly bear denning habitat suitable for motorized over-snow use by alternative.

Inside the PCA:

Like alternative A, alternatives B and D would not change the areas open to motorized over-snow vehicle use during the den emergence time period, nor the dates areas are open to motorized over-snow vehicle use. The USFWS wrote in their 5-year review for grizzly bear (USFWS 2011), "Our best information suggests that current levels of snowmobile use are not appreciably reducing the survival or recovery of grizzly bears." The NCDE population has been increasing and is likely headed towards delisting, so current levels of motorized over-snow vehicle use does not appear to be preventing the population from recovering". With alternatives B and D, areas open to motorized over-snow used during the den emergence time period would not change, so the effects would be the same as for alternative A.

With alternative C, three of the areas open to motorized over-snow vehicle used during the den emergence time period (late-season play areas) would be eliminated due to additional management restrictions and acres of Recommended Wilderness (MA1b) in areas that are currently open. Alternative C would provide the lowest potential risk of disturbance to females with cubs of all the alternatives because motorized over-snow vehicle use would no longer be suitable in late season "play areas" in the Challenge-Skyland, Lost Johnny, or Six Mile areas due to recommended wilderness (MA1b) and its associated management direction specific to alternative C. With alternative C, areas of modelled denning habitat that would remain suitable for over-snow motorized vehicle use during the den emergence time period include the groomed route in Canyon Creek and areas near Whitefish Mountain Resort, as well as routes and areas near Blacktail Mountain Ski Resort. These two areas currently receive very high levels of public recreation use.

Outside the PCA:

Outside the PCA, motorized over-snow vehicle use would be managed according to desired conditions for the winter recreational opportunity spectrum (see Winter Recreation section of Chapter 3). Most areas outside the PCA would not have restrictions on motorized over-snow vehicle use. There is a minimal amount of modelled grizzly bear denning habitat in the area outside the PCA, so the risk of disturbance or displacement to grizzly bears (including females with cubs) is very low.

Consequences of non-motorized access management direction specific to the action alternatives B, C, and D

The action alternatives (B, C, and D) differ from the no action alternative A. With alternative A, "security core" includes percentage deductions due to high use non-motorized trails used for hiking, mountain biking, and horseback riding. For Alternatives B, C, and D "secure core" is defined differently and does not include deductions due to high-use non-motorized trails.

There is no evidence of significant disturbance or displacement of grizzly bears due to non-motorized trail use, so there are no expected effects. With the action alternatives, the baseline would be updated so that high use non-motorized trails are no longer counted as a deduction from secure core. As stated in the draft GBCS, "If research demonstrates that high intensity use non-motorized trails do significantly impact grizzly bear populations or that there are areas of significantly higher mortality risk near high intensity use non-motorized trails (as opposed to other trails or roads), this new information will be appropriately considered and incorporated through an adaptive management approach". In the future, grizzly bear population monitoring would be conducted by MFWP to determine if any population level effects of human uses is occurring.

Consequences of management direction for developed recreation sites common to the action alternatives B, C, and D

<u>Within the recovery area/PCA</u>: Standard FW-STD-REC-01 states, "Within the NCDE primary conservation area, the number and capacity of developed recreation sites (GBCS definition) on NFS lands that are designed and managed for overnight use by the public during the non-denning season shall be limited to one new developed recreation site per decade per bear management unit (BMU), or one increase in the overnight capacity at one site per decade per BMU above the baseline (see glossary), with listed exceptions. A change in the number or capacity of developed recreation sites may be offset by an equivalent reduction at another site(s) in the same BMU (see also FW-STD-IFS-04).

There are 11 bear management units within the primary conservation area on the Flathead National Forest. Out of these 11, 6 are shared with other forests or agencies (e.g. National Park Service). Therefore, in the next 10 years, the Flathead National Forest has the ability to increase 5 to 11 overnight developed recreation sites in the primary conservation area. Outside of the primary conservation area, the limitation on overnight developed recreation sites is not applied.

The draft GBCS states that "The intent of the developed recreation site standard is to not increase the number of developed sites or capacity at most overnight developed sites on public Federal lands within each BMU above levels known to have occurred at a time when there was a stable to increasing grizzly bear population." While the NCDE grizzly bear population was listed as threatened under the ESA, there were occasional increases in developed sites that were approved through consultation with the USFWS. To allow a similar level of increase in developed site numbers or capacity that occurred under listed status, one increase in the capacity or number of developed sites would be allowed per BMU per 10 years. All action alternatives include Guideline FW-GDL-REC-01, which states that if increases occur, one or more measures to reduce the risk of grizzly bear–human conflicts should be incorporated into the proposal and should be in place before or concurrent with the implementation of the project. In addition, food storage orders have been in place on the Forest portion of the recovery zone/primary conservation area for over a decade. The combination of plan components benefits grizzly bears by reducing the risk of human-grizzly bear conflicts.

The Forest has one developed ski area (Whitefish Mountain Resort) in the PCA and it does not have overnight capacity on NFS lands. The ski area likely causes disturbance or displacement of grizzly bears during the non-denning season, but there have been no known grizzly bear mortalities. The Whitefish Mountain Resort has had mitigation measures in place to reduce grizzly bear-human conflicts for decades and these would continue to apply under all action alternatives. Guideline GA-SM-MA7-Big Mtn GDL-01 states, "To reduce grizzly bear-human conflicts the Whitefish Mountain Resort during the non-denning season, existing mitigation measures for grizzly bears regarding food/garbage handling, odor control, and grizzly bear education at the summit house should be retained", benefitting the grizzly bear.

Outside the recovery area/PCA: No additional limits on developed recreation sites would occur outside the primary conservation area with alternatives B, C, or D. All action alternatives include Standard FW-STD-WL-01which states that within the NCDE PCA and Zone 1 (including the Salish DCA), Food/Wildlife Attractant Storage Special Order(s) shall apply to all National Forest System lands. Food storage orders are updated over time as new information and new technologies become available, but would continue to be guided by the Interagency Grizzly Bear Committee, or similar group of experts. A food storage order has been in effect for the Zone 1 portion of the Forest for over 5 years, reducing the risk of grizzly bear-human conflicts, and females now occupy the Forest portion of Zone 1.

Consequences of management direction for grazing allotments: action alternatives B, C, and D

Inside the PCA

Alternatives B, C, and D would implement the same management direction for livestock grazing in the PCA. Grazing is a relatively minor use of NFS lands on the Flathead National Forest. As discussed for the no-action alternative, there are no sheep grazing allotments on the Flathead National Forest and existing cattle grazing allotments have been compatible with a recovering grizzly bear population. Based on the lack of history of conflicts, the risk of grizzly bear mortality associated with livestock grazing is low.

Although the Flathead National Forest has not had conflicts between cattle and grizzly bears, all action alternatives would result in reduced risk of future conflicts in the primary conservation area because they include standards FW-STD-ECOS GR-01 through FW-STD-ECOS GR-06. These standards provide management direction on limits on the number of active allotments/AUMs, bone yards where carcasses are disposed of, carcass reporting, and use of temporary permits for grazing by small livestock for purposes of weed control. All action alternatives include Guidelines FW-GDL-ECOS GR-01 through 03, which provide management direction on grazing practices and measures to protect key grizzly bear food production areas in order to reduce conflicting use by livestock. The additional standards and guidelines would promote consistency across the NCDE and minimize the potential for conflicts on NFS lands in the primary conservation area.

In addition, in order to reduce the cost of administering very small livestock allotments, the revised Forest plan includes guideline GA-SV-GDL-06 that would reduce cattle grazing allotments in the Swan Valley GA if opportunities arise with a willing permittee. This management direction is not associated with the Draft Grizzly Bear Conservation Strategy, but would further reduce risks to grizzly bears on the three grazing allotments in the Swan Valley in the future.

Outside the PCA

With alternatives B and D, standards for livestock grazing would only apply to the primary conservation area. With alternative C, standards for cattle grazing would be extended to Zone 1, including the Salish Demographic Connectivity Area, further reducing the potential for livestock conflicts with grizzly bears. The Flathead National Forest currently has active cattle grazing allotments outside the primary conservation area in the Salish Mountains GA (see figure 1-55). According to the draft GBCS, "impacts on grizzly bears due to attractants associated with livestock can be effectively minimized with requirements to securely store and/or promptly remove attractants associated with livestock operations (e.g., livestock carcasses, livestock feed, etc.)". Livestock carcasses are promptly removed and livestock feed is properly stored on Forest lands, as required by the food storage orders. As stated in the Draft Grizzly Bear Conservation Strategy, "Current levels of grazing on permitted livestock allotments in forested environments are not displacing grizzly bears in significant ways and are not likely to affect vegetation structure enough to result in direct competition for forage species on public lands within the NCDE, as evidenced by the increasing population trend in the NCDE" (USFWS 2013). As a result, the Draft Grizzly Bear Conservation Strategy included measures to keep livestock grazing at or below the baseline levels that occurred while the NCDE grizzly bear population has recovered.

Consequences of management direction for vegetation: alternatives B, C, and D

Inside the PCA

Under alternatives B, C, and D, there would no longer be a distinction between management direction on MS-1, MS-2, or MS-3 lands within the recovery area/PCA. The Standards and guidelines applicable to vegetation management projects are applied throughout the recovery zone/primary conservation area.

With alternatives B, C, and D, FW-GDL-TE &V-01 through 05 would apply to the primary conservation area. These guidelines are very similar to the Interagency Grizzly Bear Guidelines and would benefit the grizzly bear because they promote a mosaic of successional stages; restrict logging activities in time and space as needed; design projects to maintain or improve grizzly bear habitat quality or quantity where it would not increase the risk of grizzly bear-human conflicts; and retain cover as needed along grass, forb and shrub openings (see appendix C). In addition, because riparian management zones (RMZs) would be managed to benefit fish and wildlife, key wetland and riparian habitats used by grizzly bears would continue to support their needs.

With all action alternatives, the vegetation management direction that applies to areas managed for timber production would provide for diverse habitats and promote bear foods. For example, vegetation desired condition FW-DC-TE&V-11 states that the forest groundcover consists of a variety of grass, forb, and shrub species, including species berry-producing species that provide forage for grizzly bears and other wildlife species (e.g. huckleberries (Vaccinium globulare, Vaccinium membranaceum), serviceberries (Amalanchier alnifolia), mountain ash (Sorbus scopulina), and buffaloberry (Shepherdia Canadensis). This desired condition may be met in wildfire areas, prescribed burn areas, or areas managed for timber production.

Alternatives vary with respect to the distribution, rate, and type of timber harvest that would occur (see table 13 in the vegetation section for more details). For example, there would be more commercial thinning and small group selection with alternative B, whereas there would be more regeneration harvest with alternative D. There would be more vegetation management with prescribed burning with Alternative C. All alternatives (A,B, C, and D) must follow standards VEGS1, VEGS2, VEGS5 and VEGS6 in the Northern Rockies Lynx Management Direction Appendix F), so this would limit vegetation treatments, especially in areas outside the wildland-urban interface. These limitations on vegetation management would also provide cover for grizzly bears. Timber salvage of areas burned by wildfire or killed by insects/disease may occur and would be subject to forestwide management guidelines in the Forest Products- Timber section of the plan, but its location is very unpredictable. Salvage harvest generally has minor effects on grizzly bear cover and forage.

Grizzly bear habitat and its use by grizzly bears would vary across time and space due to natural processes (e.g. succession, wildfires, insects/disease), and vegetation management activities (timber harvest, planting, precommercial thinning) and activities in the primary conservation area would continue to be assessed with through project-specific analysis as conditions change. The grizzly bear is a habitat generalist that is adaptable to these changing vegetative conditions. Although there are known, usually short-term, impacts to individual bears from vegetation management activities and associated road use, these impacts have been and would continue to be managed to support a recovered grizzly bear population.

All action alternatives have guideline FW-GDL-TE&V-01 to reduce the risk of grizzly bear disturbance or displacement through timing of timber sale activities in the PCA. Alternatives B, C, and D allow for temporary increases in open and total motorized route density and temporary decreases in secure core under FW-STD-IFS-03 to allow for projects.

Table 55 displays acres of grizzly bear secure core and the percentage that could have a temporary decrease in secure core due to projects (see glossary). There is no timber harvest in wilderness. Timber management opportunities are expected to continue to be limited within inventoried roadless areas and harvest within these areas may be infeasible due to the high cost of harvesting timber where there are no roads. As a result, these areas are unlikely to have temporary changes due to projects. With all alternatives, an interconnected network of Wilderness areas and IRAs totaling about 1.6 million acres would provide areas where there would not be temporary increases in motorized access densities or temporary decreases in secure core, meeting the needs of the grizzly bear, as they have during the time period when grizzly bears were recovering (see figures 1-37 to 1-42 for grizzly bear secure core).

Table 54. Grizzly bear and potential decreases in secure core due to projects

Management Areas	Alternative B	Alternative C	Alternative D
Wilderness and IRAs combined	1,548,666 acres	1,548,666 acres	1,548,666 acres
Additional recommended wilderness (outside of IRAs) in the PCA (MA1b)	14,340 acres	38,973 acres	0 acres
% of secure core in the PCA in MAs 3a, 4b, 6a, b, c, and 7 where temporary decrease may occur	7%	3%	8%

Although there may be short-term impacts to individual bears from temporary changes due to projects (e.g. timber management activities and associated use of roads that are closed to the public), these impacts have been and would continue to be managed to provide for the needs of the grizzly bear. This type of limited temporary change has been evaluated and allowed through project-level section 7 consultations, in order to accommodate post-fire salvage, timber harvest, and road management projects in the NCDE. Page 51 of the draft grizzly bear conservation strategy describes six projects affecting 18 subunits, and the temporary changes that were allowed, which provided the basis for NCDE-AR-STD-03. This standard limits temporary disturbance or displacement of grizzly bears due to project activities so that secure habitat remains available during project activities and occurs over a limited number of years. The grizzly bear population has recovered during the time period when these temporary changes occurred. By adding this standard, the allowances made for project implementation are expected to continue.

All action alternatives include standard FW-STD-TE&V-01 which states that within the NCDE primary conservation area, all proposed vegetation management projects shall be evaluated for their effects on grizzly bears and their habitat. All action alternatives include the following guidelines which apply to the NCDE Primary Conservation Area:

FW-GDL-TE &V-01 states that vegetation and fuels management activities should be restricted in time and space if needed to reduce the potential for adverse grizzly bear disturbance/displacement, as determined by site-specific analysis (see appendix C for strategies, since this will vary on a site-specific basis).

FW-GDL-TE &V-02 states that vegetation management activities should be designed to avoid detrimental effects on the grizzly bear population and to include one or more measures to protect, maintain, increase and/or improve grizzly habitat quantity or quality in areas where it would not increase the risk of grizzly bear–human conflicts (see appendix C for strategies, since this will vary on a site-specific basis).

FW-GDL-TE &V-03 states that measures to retain cover should be included in the project design if vegetation management activities would result in the loss of cover along grass/forb/shrub openings, riparian wildlife habitat, or wetlands, as determined by a site-specific analysis (see appendix C for strategies, since this will vary on a site-specific basis).

FW-GDL-TE &V-04 states that vegetation management projects (including timber sales and other non-commercial vegetation management contracts) should include a provision providing for modification, cancellation, suspension, or temporary cessation of activities, if needed, to resolve a grizzly bear-human conflict situation.

FW-GDL-TE &V-05 states that vegetation management activities that may enhance grizzly habitat or attract bears (e.g., increase huckleberry production) should be avoided near campgrounds, facilities or other developed sites.

In summary, the vegetation plan components provide for key ecosystem characteristics to support the grizzly bear and would reduce the potential for grizzly bear displacement through timing of timber sale activities. Although there may be short-term impacts to individual bears from timber management activities and associated road use, these impacts have been and would continue to be managed acceptably to support a recovered population.

Outside the PCA

Alternative C differs from the other alternatives because it extends vegetation management standard FW-STD-TE &V-01 and guidelines FW-GDL-TE &V-01 through 05 to the Salish DCA. The effect of this would likely be to reduce the potential for adverse grizzly bear disturbance/displacement and to design vegetation management activities to protect, maintain, increase and/or improve grizzly habitat quantity or quality within the Salish Demographic Connectivity Area where it would not increase the risk of grizzly bear–human conflicts. This would be beneficial by supporting occupancy by female grizzly bears.

Consequences of management direction for minerals: effects common to action alternatives B, C, and D

Recovery zone/PCA: Mineral development can affect grizzly bears by causing long-term loss of habitat, increasing vehicle collisions, and increasing grizzly bear disturbance/displacement, and increasing grizzly bear-human conflicts at camps. Compared to the no-action alternative, the action alternatives have more stipulations (such as NSO) and mitigation measures for grizzly bears that apply to new mineral activities. All action alternatives include Standards FW-STD-ECOS E&M-01 thru 08 and Guidelines FW-GDL-ECOS E&M-01 thru 07 which would mitigate effects of any future leasable or locatable minerals activities. Nonetheless, there is likely to be very little difference in consequences of the no-action alternative compared to the action alternatives because the Flathead National Forest currently has no leasable or locatable mineral activity, has over 50% of the land area with wilderness and/or wild and scenic river designation with “no surface occupancy”, and has most of the remaining land areas with low potential for development.

Consequences of management direction for minerals: effects specific to action alternative C

Although the Forest has very low potential for oil and gas leasing, Alternative C would lower the risk of grizzly bear habitat loss and increased mortality risk even further because NCDE-STD-MIN-08 would require that no surface occupancy stipulations be applied to any new oil and gas leases in the PCA and zone 1. As with alternative A, no activity can take place on suspended oil and gas leases until an EIS is completed. A leasing decision will not be a part of this Forest Plan Revision.

Consequences of management direction for habitat connectivity: the action alternatives B, C, and D

Alternatives B, C, and D provide for habitat connectivity during the non-denning season, both in terms of cover and in terms of areas with low levels of human disturbance, as described above. Alternatives B, C and D do not specifically address connectivity with respect to grizzly bear habitat, but all alternatives would support connectivity for grizzly bears because they include the following plan components:

- Appendix F: ALL 01, ALL S1, ALL G1, LINK 01, LINK S1, LINK G1, G2 for Canada lynx;
- plan components for riparian connectivity (FW-DC-WTR-02, FW-STD-RMZ-01,02, 03,04);
- plan components for forest vegetation connectivity (FW-DC-TE&V-15, FW-DC-TE&V-19, FW-STD-TE&V-02, 04; FW-GDL-TE&V-06 thru 11, MA6 a,b,c-DC-02);plan component FW-GDL-IFS-13 which states that within areas specifically identified as being important for wildlife connectivity across highways5, the USFS should cooperate with highway managers and other landowners to implement crossing designs that contribute to wildlife and public safety.

Geographic area desired conditions GA-HH-DC-02, GA-MF-DC-06, GA-NF-DC-07, 08; GA-SM-DC-03, and GA-SV-DC-09 address connectivity in areas that have been modelled as being important for several wide-ranging carnivores or big game species including Canada lynx, wolverines, grizzly bears, and elk. For example, GA-HH-DC-03, states that the Coram connectivity area (see appendix 3 figure 2) provides habitat connectivity for a north-south movement corridor for wide-ranging species (e.g., grizzly bear, Canada lynx, wolverine) moving between the southern and northern watersheds on the Forest.

FW-GDL-IFS 02 states that NFS lands should be retained in public ownership or acquired by purchase, donation, exchange, other authority as opportunities arise to improve national forest management. This desired condition and guideline benefit grizzly bears in the Salish DCA.

<u>Consequences of management direction for demographic connectivity:</u>

Demographic connectivity considers the genetic interchange between the Forest portion of the NCDE and the Cabinet-Yaak Ecosystem for grizzly bears. Management direction specific to the Salish Demographic Connectivity Area provides for female grizzly bear occupancy in the area outside the recovery zone/primary conservation area and addresses genetic interchange with the Cabinet-Yaak Ecosystem (CYE). In the last decade, MFWP has also translocated grizzly bears from the NCDE to the CYE in order to facilitate genetic interchange. In recent years, the number of documented grizzly bear reports in the area outside the recovery zone has been increasing as the population in the NCDE increases. More grizzly bears are exploring new territory further to the west (Mace and Roberts 2012).

Alternative C places even more emphasis on connectivity than the other alternatives. This alternative includes desired Conditions GA-SM-DC-08 which states, “in areas between the primary conservation area and the Salish Demographic Connectivity Area, National Forest System lands are consolidated and

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5Ament, R., R. Callahan, M. McClure, M. Reuling, and G. Tabor. 2014. Wildlife Connectivity:

Fundamentals for conservation action. Center for Large Landscape Conservation: Bozeman,

Montana (or subsequent updates).

conservation easements with willing landowners are supported in a manner that provides habitat connectivity and facilitates movement of wildlife”.

Summary of alternative consequences- management areas

Because grizzly bears are habitat generalists, consequences described under the wildlife diversity sections for ecosystems/key ecosystem characteristics apply to the grizzly bear. Forestwide management direction is followed regardless of MA management direction, but the number of unique management areas and their specific attributes differ between the existing forest plan (Alternative A) and the action alternatives B, C, and D. There are different MAs in the no action alternative than there are in the action alternatives, so a cross-walk of MAs was used for comparison purposes (see table 3, cross-walk of management areas for alternative A).

The management areas by alternative are displayed in table 5 of the DEIS (also see the forestwide management area maps, figures 1-01 to 04). Management areas by geographic area are included in chapter 4 of the draft forest plan and the corresponding maps are figures B-32 through B-49.

Consequences of management area direction: the no-action alternative A

Summary and conclusion for alternative A

The current forest plan, which incorporated the Interagency Grizzly Bear Guidelines, has been effective in contributing to the improved status of the NCDE grizzly bear population. Grizzly bear habitat on the Flathead National Forest is anchored by close to 1.2 million acres in MAs 1a, 1b, and 5a (non-motorized year-round) that are unlikely to be affected by human disturbance at a level that would impact grizzly bears. This alternative also included a management area that specifically emphasized grizzly bear habitat management on about 175,000 acres in the Trail Creek, Bunker Creek and Swan areas.

In other management areas, the Forest would continue to decrease open and total road densities in grizzly bear subunits that do not meet 19-19-68, further increasing the existing level of habitat security on NFS lands within the recovery zone/PCA. Some minor effects to individual bears would be anticipated under this alternative due to temporary increases in open and total road density and temporary decreases in habitat security for projects (e.g. timber sales). This alternative has the highest percentage in MAs where timber harvest would be likely to occur—about 33% in MA’s 4b, 6a, 6b, 6c, and portions of 7. These MAs occur on about 557,000 acres in the PCA and about 211,000 acres of Zone 1. The grizzly bear population has recovered under implementation of this alternative, so continued implementation of the no-action alternative is expected to be compatible with contributing to a recovered grizzly bear population on National Forest System lands.

There would continue to be a risk of grizzly bear displacement in management MA 7, focused recreation areas, totaling about 5,600 acres across the Forest. Recreation activities are expected to be more concentrated in these areas, which could be beneficial to grizzly bears if it concentrates use in smaller areas, rather than having higher levels of use dispersed across a larger area. Implementation of food storage orders would continue to minimize the potential for grizzly bear-human conflicts and bear mortality across the Forest. Energy and mineral development has been minor on the Forest and is expected to continue to be so in the future. The existing forest plan does not limit livestock grazing, developed recreation sites, and does not contain the regulatory framework necessary for de-listing of the NCDE population.

Summary and conclusion for alternative B

Grizzly bear habitat on the Flathead National Forest would be anchored by over 1.4 million acres in in MAs 1a, 1b, and 5a (non-motorized year-round) that are unlikely to be affected by human disturbance at a level that would impact grizzly bears. With this alternative the grizzly bear habitat areas in Trail Creek, and a portion of Bunker Creek are included in recommended wilderness, MA1b. Existing mechanized transport and motorized over-snow use would be suitable in recommended wilderness as long as certain conditions are maintained (see Recreation section of Chapter 3 for more details). This alternative has the same percentage as D for MAs where timber harvest would be likely to occur—about 30% in MA's 4b, 6a, 6b, 6c. Alternatives B has the greatest potential for temporary increases in motorized access for projects in the PCA, because this alternative has the greatest number of acres in MA's 4b, 6a, 6b, and 6c (about 499,000 acres). Outside the PCA in Zone 1, alternatives B and C have a very similar number of acres in these MAs (about 215,000 acres). There would be a risk of grizzly bear displacement in management MA 7, focused recreation areas, totaling about 33,000 acres across the Forest. Recreation activities are expected to be more concentrated in these areas, which could be beneficial to grizzly bears if it concentrates use in smaller areas, rather than having higher levels of use dispersed across a larger area. Implementation of food storage orders would continue to minimize the potential for grizzly bear-human conflicts and bear mortality across the Forest.

Under this alternative, the revised Flathead Forest Plan would incorporate standards to maintain baseline levels of open and total motorized route density and secure core in the primary conservation area that have supported grizzly bear habitat recovery. The existing situation has been effective in contributing to the recovery of the grizzly bear population in the NCDE, and updating the management direction to incorporate the draft grizzly bear conservation strategy would provide consistency across National Forest System lands in the NCDE so that conditions supporting recovery are maintained. The management direction applicable to the Salish demographic connectivity area is expected to support occupancy by grizzly bears, including female bears. Some effects to individual bears would be anticipated as a result of forest management actions under this alternative, but continued implementation of this alternative would contribute to a recovered grizzly bear population on National Forest System lands in the NCDE.

This alternative would update management direction for coordination of various resource management programs with grizzly bear habitat in the primary conservation area, including livestock grazing and developed recreation. Energy and mineral development has been minor on the Forest and is expected to continue to be so in the future, but this alternative includes additional requirements to mitigate effects to grizzly bears. Alternative B provides the regulatory framework necessary for de-listing of the NCDE population and would provide consistency across National Forest System lands in the PCA, so that habitat conditions supporting recovery are maintained.

Summary and conclusion for alternative C

Grizzly bear habitat on the Flathead National Forest would be anchored by over 1.6 million acres in MA's 1a, 1b, and 5a (non-motorized year-round) that are unlikely to be affected by human disturbance at a level that would impact grizzly bears. With this alternative grizzly bear habitat in the Trail Creek, Bunker Creek and Swan areas would be Recommended Wilderness, MA 1b. This alternative also has the most restrictions on management of Recommended Wilderness areas, because mechanized and motorized uses would not be suitable in MA 1b, reducing the future risk of all motorized and mechanized forms of human disturbance in all seasons more than other alternatives. This alternative has the lowest percentage in MAs where timber harvest would be likely to occur—about 26% in MA's 4b, 6a, 6b, 6c and portions of 7. It has the lowest potential for temporary increases in motorized access for projects in the PCA. Some minor effects to individual bears would be anticipated as a result, but application of forestwide standards and guidelines would be expected to continue to support a recovered grizzly bear population on National Forest System lands.

There would continue to be a risk of grizzly bear- displacement in management MA 7, focused recreation areas, totaling about 31,100 acres across the Forest. This acreage is slightly less than alternative B, because the Krause Basin Area would not become a focused recreation area. Recreation activities are expected to be more concentrated in these areas, which could be beneficial to grizzly bears if it concentrates use in smaller areas, rather than having higher levels of use dispersed across a larger area. Implementation of food storage orders would continue to minimize the potential for grizzly bear-human conflicts and bear mortality across the Forest

As with the other action alternatives, the revised Flathead Forest Plan would incorporate standards to maintain baseline levels of open and total motorized route density and secure core in the primary conservation area that have supported grizzly bear habitat recovery.

The same changes to forest plan desired conditions, standards, guidelines and monitoring items would be made as under Alternatives B and D. In addition, several additional desired conditions, standards and guidelines would be added. Four additional standards would be applied in the primary conservation area. NCDE-STD-AR-04 would be modified to explicitly state that roads within secure core cannot be opened for temporary motorized use by the public. This would reduce the risk that female grizzly bears with cubs would be disturbed or displaced from secure core by the public. NCDE-STD-AR-07 would require that new or reauthorized ski area permits include mitigation measures to reduce the risk of grizzly bear-human conflicts. NCDE-STD-AR-08 would not allow any increase above the baseline in areas or routes open to use by motorized over-snow vehicles in the non-denning (i.e. late spring) season. This, in concert with additional recommended wilderness, would reduce potential impacts to bears, particularly females with cubs, because areas where snowmobile use would be suitable in the den emergence period would be greatly reduced in size (see figures B-03 to B-05). NCDE-STD-MIN-08 would require that no surface occupancy stipulations be applied to any new oil and gas leases in the primary conservation area and zone 1. Taken together, these additional standards and management area direction would lower the risk of grizzly-bear human conflicts and displacement in the future. Thus, alternative C would be more protective of individual grizzly bears than the other two alternatives. Alternative C provides the regulatory framework necessary for de-listing of the NCDE population and would provide consistency across National Forest System lands in the NCDE, so that habitat conditions supporting recovery are maintained.

Summary and conclusion for alternative D

Similar to alternative B, grizzly bear habitat on the Flathead National Forest would be anchored by almost 1.4 million acres that are unlikely to be affected by human disturbance at a level that would impact grizzly bears. However, alternative D would have no acres in Recommended Wilderness and more acres in a variety of backcountry MAs (see Recreation section of Chapter 3 for more details). Outside the PCA, alternative D has slightly less acres in category 5 than alternatives B and C. Reasons for this are varied, but for example, alternative D has a larger forest-wide acreage of MA7, focused recreation areas, especially in areas close to human communities. Some focused recreation areas would be managed for timber production, but others would not (see Recreation section of Chapter 3 for more details). Alternatives D has more potential for temporary increases in motorized access for projects in the PCA than alternative C, because this alternative has more acres in MAs 4b, 6a, 6b, and 6c (about 487,000) compared to about 372, 000 for alternative C. Outside the PCA there would be more emphasis on regeneration harvest, especially in the wildland-urban interface.

As with the other action alternatives, the revised Flathead Forest Plan would incorporate standards to maintain baseline levels of open and total motorized route density and secure core in the primary conservation area that have supported grizzly bear habitat recovery.

The existing situation for roads has been effective in contributing to the recovery of the grizzly bear population in the NCDE, and updating the management direction to incorporate the draft grizzly bear conservation strategy would provide consistency across National Forest System lands in the NCDE so that conditions supporting recovery are maintained. The management direction applicable to the Salish demographic connectivity area is expected to support occupancy by grizzly bears, including female bears. Some effects to individual bears would be anticipated as a result of forest management actions under this alternative, but continued implementation of this alternative would contribute to a recovered grizzly bear population on National Forest System lands in the NCDE.

There would continue to be a risk of grizzly bear-human conflicts on NFS lands, especially in management MA 7, focused recreation areas, totaling about 61,000 acres across the Forest. Recreation activities are expected to be more concentrated in these areas, which could be beneficial to grizzly bears if it concentrates use in smaller areas, rather than having higher levels of use dispersed across a larger area. Implementation of food storage orders would continue to minimize the potential for grizzly bear-human conflicts and bear mortality across the Forest.

This alternative would update management direction for coordination of various resource management programs with grizzly bear habitat in the primary conservation area, including livestock grazing and developed recreation. Energy and mineral development has been minor on the Forest and is expected to continue to be so in the future, but this alternative includes additional requirements to mitigate effects to grizzly bears. Alternative D provides the regulatory framework necessary for de-listing of the NCDE population and would provide consistency across National Forest System lands in the NCDE, so that habitat conditions supporting recovery are maintained.

In summary, implementing these sets of plan components is expected to continue to support a recovered grizzly bear population in the NCDE. Alternatives B, C, and D provide the regulatory framework to support de-listing of the NCDE grizzly bear population.

Cumulative effects on the grizzly bear

For a discussion of cumulative effects to the grizzly bear, see volume 3.

Canada lynx

Key indicators for analysis

The Lynx Conservation Strategy and Assessment (Interagency Lynx Biology Team 2013) identified anthropogenic influences that may affect lynx and lynx habitat, sorted into either the "upper tier" or the "lower tier". The upper tier includes the anthropogenic influences that are of greatest concern to the conservation of the lynx: climate change, vegetation management, wildland fire management, and fragmentation of habitat. The "lower tier" of anthropogenic influences include recreation (primarily snowmobiling), minerals and energy management, forest/backcountry roads and trails, grazing by domestic livestock and mortality due to incidental trapping or illegal shooting. It is thought that the lower tier activities could affect individual lynx, but are not likely to have a substantial effect on lynx populations, and are of less concern for conservation of the species.

Each of the anthropogenic influences are briefly described below, grouped into those that are under USFS control vs. those that are not. The way in which each may operate as a stressor for lynx and/or lynx habitat is discussed. For those that are under USFS control, the effects analysis for the no action alternative considers the previous analysis and decision under the Northern Rockies Lynx Management Direction FEIS (USDA 2007), and assesses the effects of changed conditions or proposed modifications to the forest plan components under the action alternatives. The effects of those that are not under USFS control are considered in the cumulative effects section. Stressors can be activities that have occurred in the past, but may not be occurring presently, nor are they necessarily expected to occur in the future. These are activities that might impact a species and its habitat if not managed or mitigated.

Key stressors under USFS control

Below, each anthropogenic influence is described and the mechanism by which it may operate as a stressor is summarized.

<u>Vegetation management</u>: Vegetation management activities such as timber harvest, fuels reduction, planting and precommercial thinning can affect lynx habitat by influencing stand composition and structure, the amount and distribution of dense horizontal cover providing snowshoe hare habitat, the amount and availability of large down wood and the development of multi-story canopy layers (Interagency Lynx Biology Team 2013). Timber harvest can also affect the diversity of successional stages and connectivity of lynx habitat within and between lynx analysis units. The effects on lynx may be positive, neutral or negative.

<u>Wildland fire</u>: Stand-replacing wildfires (the most common type within lynx habitat on the Forest) remove understory vegetation and tree canopy cover in the short-term, but can promote development of dense horizontal cover and recruitment of large down wood in the longer-term. Boreal forest types on the Forest are prone to stand-replacing wildfires about every 100 years. On the Forest, about 20 years must pass after the fire before vegetation re-establishes and grows sufficiently tall and dense enough to provide winter snowshoe hare habitat. During the early post-fire period, a large stand-replacing fire may negatively impact the ability of a lynx to secure food resources within its home range.

<u>Fragmentation of habitat</u>: Human-caused alterations of natural landscape patterns can reduce the total area of habitat, increase the isolation of habitat patches, and impair the ability of wildlife to effectively move between those patches of habitat (Interagency Lynx Biology Team 2013). Habitat fragmentation may be permanent, for example by converting forest habitat to residential or agricultural purposes, or temporary, for example by creating an opening but allowing trees and shrubs to regrow. Both lynx and their snowshoe hare prey are influenced by the spatial arrangement of their preferred habitats.

Recreation: Recreational activities potentially may impact lynx through loss of habitat, behavioral responses to human disturbance, or due to snow compaction that may result in changes in competition for snowshoe hare prey (Interagency Lynx Biology Team 2013).

Large developments such as ski areas can result in habitat loss and/or fragmentation. The Whitefish Mountain Resort (formerly known as Big Mountain) is within lynx habitat and designated critical habitat. The Blacktail Mountain Resort is in lynx habitat, but is not within designated critical habitat (USFWS 2014). Habitat loss occurs within ski resorts from the clearing of trees for ski runs and roads, lift infrastructure, restaurants, warming huts, ski patrol and maintenance buildings, and the like. Glading of slopes, removal of down woody debris, and snow compaction negatively affect winter snowshoe hare habitat.

Some anecdotal information suggests that lynx are quite tolerant of humans, although this has not been well studied. A variety of behavioral responses may be expected from individual lynx and in different contexts (Interagency Lynx Biology Team 2013).

It was hypothesized that snow compaction could allow competing predators (e.g., coyotes) that are normally restricted to shallow snow areas to successfully forage for snowshoe hares in lynx habitat. However, Kolbe et al. (2007) found that compacted trails from over-snow motorized vehicles in their study area (western Montana) had only minimal impacts on coyote movements and foraging success, and that snowshoe hares were an insignificant portion of the winter diet of coyotes. The biological opinion for the Northern Rockies Lynx Management Direction (pages 53-55 in USFWS 2007) concluded that compacted snow routes would not increase competition from other species to levels that adversely impact lynx populations, although it is possible that in some specific cases a project could adversely affect individual lynx.

Mineral and energy development: Impacts to lynx from mineral activities could include the potential alteration or removal of lynx habitat, increased fragmentation, and the potential for human-caused mortality from high speed or high traffic levels on roads.

Forest roads and trails: Construction of roads results in a small reduction of lynx habitat by removing forest cover. On the other hand, in some instances the vegetation along forest roads may provide good snowshoe hare habitat, and lynx may use the roadbed for travel and foraging (Koehler and Brittell 1990). Mortalities of lynx due to vehicle collisions have been documented in Colorado (reintroduced animals on paved highways), in Minnesota (on paved highways), in Maine (on high-speed gravel roads), and in Montana (on highways). Collisions are unlikely to occur on forest roads that are traveled at slower speeds and have lighter traffic volumes than highways. Extensive (>600 km) backtracking studies in Montana found that lynx did not avoid gravel forest roads (Squires et al. 2010). Trails are typically narrow routes with a native surface; there is no information to suggest that trails have negative impacts on lynx (Interagency Lynx Biology Team 2013).

Livestock grazing: There is no existing research indicating that grazing or browsing by domestic livestock on federal lands would reduce the snowshoe hare prey base or have a substantial effect on lynx (Interagency Lynx Biology Team 2013). However it is possible that livestock browsing or grazing could reduce the forage and dense horizontal cover needed by snowshoe hares.

Key stressors not under USFS control

Future climate changes: Possible effects on lynx as a result of future changes in climate include: 1) potential upward shifts in elevation or latitudinal distribution of lynx and their prey; 2) changes in the periodicity or loss of snowshoe hare cycles in the north; 3) reductions in the amount of lynx habitat and associated lynx population size due to changes in precipitation, particularly snow suitability and persistence, and changes in the frequency and pattern of disturbance events (e.g., fire, insect outbreaks); 4) changes in demographic rates of lynx, such as survival and reproduction; and 5) changes in predator-prey relationships. The Lynx Conservation Assessment and Strategy did not provide management recommendations specific to climate change, although it did identify several information needs. Possible future effects on lynx and lynx habitat are discussed in the cumulative effects section.

Fragmentation of habitat due to highways or activities on private and state lands: The Flathead National Forest does not have jurisdiction over state and federal highways, or lands on other ownerships (e.g., private, state, tribal). The Forest Service can support habitat connectivity through its management of NFS lands, by encouraging or acquiring conservation easements along highways, or cooperating in identifying appropriate locations for installation of highway crossing structures. Activities on other ownerships are discussed in the analysis of cumulative effects.

Mortality due to incidental trapping or illegal shooting of Canada lynx: Trapping, snaring and shooting of lynx is currently prohibited in the contiguous United States. Trapping for other furbearer species does occur in Montana, and is regulated by MFWP. Lynx occasionally are captured in traps set for other species. A trapped lynx can be released, but there is a risk of injuries or unintended mortality, which is known to have occurred in Montana. The Flathead National Forest can indirectly affect lynx vulnerability to incidental trapping by providing motorized access during winter, the time period when most trapping for other furbearer species occurs.

Methodology and Analysis Process

Information Sources

A synthesis of information on lynx biology and ecology can be found in "Ecology and Conservation of Lynx in the United States" (Ruggiero et al. 1999) and in "The Canada Lynx Conservation Assessment and Strategy" (Interagency Lynx Biology Team 2013). The final rule listing the lynx (Federal Register vol. 65, no. 58, pp. 16052-16086, Friday, March 24, 2000) and the notice of remanded determination (Federal Register vol. 68, no. 128, pp. 40076-40101, July 3, 2003) evaluated population status and threats for the contiguous United States distinct population segment. The recovery outline (USFWS 2005) provided preliminary recovery objectives and actions based on an understanding of current and historical lynx occurrence and lynx population dynamics in the contiguous United States. The Northern Rockies Lynx Management Direction amended eighteen forest plans for the national forests in Idaho, Montana, Utah, and Wyoming, including the Flathead National Forest (USDA 2007). The amendment adopted forest plan components applicable to vegetation management, livestock grazing, human uses, and linkage areas in order to conserve and promote the recovery of the lynx, by reducing or eliminating adverse effects from land management activities on National Forest System lands, while preserving the overall multiple-use direction in existing plans.

The above sources provide a comprehensive set of scientific information about the lynx, its habitat requirements and its response to human activities. These documents along with subsequently-published literature constitute the best available scientific information, which provided the basis for the planning process.

Analysis area and temporal scale of analysis

Lynx habitat within the Northern Rockies Geographic Area has been divided into lynx analysis units to facilitate analysis, management and monitoring. Lynx analysis units do not depict actual lynx home ranges, but are approximately the size of a female's home range (25-50 mi^2), contain at least 10 mi^2 (6,400 acres) of primary vegetation capable of supporting lynx, and encompass year-round foraging and denning habitat components (Interagency Lynx Biology Team 2013). Lynx analysis units were delineated for the Flathead National Forest in accordance with guidance provided in the Lynx Conservation Assessment and Strategy and the Northern Rockies Lynx Management Direction.

Initial mapping of lynx habitat and delineation of lynx analysis units was done for the Flathead National Forest in 2000. At the forest-wide scale, biophysical attributes that can be derived from remote sensing data are used to identify potential lynx habitat. For example, maps such as elevation (to predict areas that likely provide deep, fluffy snow conditions for extended periods of time) and potential vegetation groups (to identify boreal forest types used by lynx) are used to model lynx habitat. This information can also be used to classify non-forest areas (e.g., rock, water) and exclude them from lynx habitat. The resulting map provides an estimate of the overall area that is capable of providing habitat for lynx. At any given point in time, some of this habitat is in a suitable condition and some provides lynx habitat in an unsuitable condition (see glossary). Satellite imagery and forest databases can accurately classify recently harvested and burned areas, which helps to identify areas that are currently in an unsuitable condition (see glossary). However, satellite imagery cannot detect dense horizontal cover that provides snowshoe hare habitat in a multistory forest structure, or coarse woody debris for denning habitat, which are important features of lynx foraging habitat. Therefore no forestwide estimates are made for these components of lynx habitat. During site-specific planning, the forestwide map of lynx habitat is field-truthed and refined, and lynx habitat is further characterized to estimate the amount and distribution of foraging and denning habitat components.

When the Northern Rockies Lynx Amendment was completed in 2007, the estimated amount of lynx habitat on the Flathead National Forest was about 1,770,000 acres. In 2013, the estimate was updated to incorporate new information. The data sources and methods are described in planning record exhibit V-24, and were reviewed by USFWS and Regional Office staff. The updated estimate of lynx habitat is about 1,795,000 acres (see figure B-17).

The area covered by the lynx analysis units on the Forest was the primary area used for analysis of effects on lynx. For analysis of cumulative effects, the area selected should be large enough to include the effects of activities on adjoining lands, but not so large as to obscure effects on a biologically meaningful unit. For lynx, the area selected for analysis of cumulative effects is the area identified by Squires et al. (2013) as the current distribution of lynx in western Montana. This is an area of about 8.9 million acres in size that includes portions of the Flathead and Kootenai National Forests, the Seeley Lake and Lincoln Ranger districts on the Lolo and Helena NFs, as well as Glacier National Park. This area was delineated by compiling lynx radiotelemetry location data from 1998-2007 as well as the locations of lynx captured on the Forest from 2009-2015. Consideration of the Northern Rockies Geographic Area, a region encompassing 18 national forests and an estimated 18.5 million acres of lynx habitat in Montana, Idaho, Wyoming and Utah, and adjoining areas in Canada also provided context for the analysis of cumulative effects.

The period considered for the analysis of indirect effects of the alternatives is the anticipated life of the forest plan, which is generally about 15 years. However lynx habitat is dynamic, becoming more suitable or less suitable for snowshoe hares and lynx as forest vegetation develops through time. Both natural events (e.g., wildfire, windthrow, forest insects and pathogens, plant succession) and vegetation management (e.g., timber harvest, fuels reduction, planting and thinning) alter forest composition and structure. Vegetation dynamics and climate change were evaluated over longer time periods. The SIMPPLLE model was used to estimate the natural range of variation as it would have influenced forest ecosystems on the Flathead National Forest going back about a thousand years (also see Forest Vegetation and Fire sections in chapter 3). Effects of the alternatives on lynx habitat were modeled by Ecosystem Research Group (ERG) in 2015 (see DEIS appendix 3). ERG modeled several scenarios for comparison purposes, including a warmer/drier climate over the next five decades that resulted in more acres burned (due to expected climate change), as well as continuing the current level of fire suppression into the future.

Affected environment

Lynx population distribution and status

The range of Canada lynx extends from Alaska across much of Canada (except for the coastal forests), with southern extensions into parts of the western United States, the Great Lakes region, and the northeast. Lynx distribution is closely aligned with the distribution of snowshoe hares and boreal forests (McKelvey et al. 1999).

The lynx recovery outline (USFWS 2005) stratified lynx habitat into 3 categories; core, secondary, and peripheral. Core areas are places where long-term persistence of lynx and recent evidence of reproduction have been documented, and the quality and quantity of habitat is available to support both lynx and snowshoe hare life needs. The lynx recovery outline emphasized focusing conservation efforts on core areas to ensure the continued persistence of lynx in the contiguous United States. Six core areas were identified in the recovery outline, one of which is in northwestern Montana/northeastern Idaho. The Flathead National Forest is located entirely within the northwestern Montana/northeastern Idaho core area.

Museum records, trapping data and other information verify the historical occurrence of lynx in western Montana (McKelvey, Aubry, and Ortega 1999). Squires et al. (2013) compiled lynx distribution data collected from 1998-2007, including 81,523 telemetry points obtained from 64 resident lynx. Their best estimate of the current distribution of lynx in western Montana is an area about 8.9 million acres in size, ranging from the Purcell Mountains east to Glacier National Park, then south through the Bob Marshall Wilderness Complex to Highway 200. The Flathead National Forest lies in the heart of this area, highlighting its importance to lynx conservation.

Lynx are known to be distributed throughout the Flathead National Forest. During 2010–2015, 15 individual adult or sub-adult lynx were captured and fitted with radiotelemetry collars on the Flathead National Forest, confirming that the North Fork, Middle Fork, and South Fork of the Flathead River drainages were occupied by lynx (L. Olson pers. comm. 2015). In addition, the Flathead National Forest has conducted carnivore monitoring in cooperation with Northwest Connections from 2011–2015 using remote cameras, hair snares, and track surveys. This effort detected additional lynx tracks in the Salish Range and an additional female with two kittens on the east side of Hungry Horse Reservoir.

Maintaining connectivity with lynx populations in Canada is an important consideration for long-term persistence of lynx in the northern Rockies (Interagency Lynx Biology Team 2013). Squires et al. (2013) combined resource selection, step selection, and least-cost path models to predict movement corridors for lynx in the northern Rocky Mountains. The models identified a few putative corridors that extend south from the international border. Currently there is no evidence that there are significant impediments to lynx movements or that genetic isolation is occurring in western Montana (Squires et al. 2013).

Lynx habitat

Habitat description

Snowshoe hares are the primary winter prey of lynx in Montana (Squires and Ruggiero 2007), and throughout the range of lynx (Aubry et al. 1999). Lynx are highly specialized predators of snowshoe hares, with unique adaptations that include a lightweight body frame and proportionately large paws that enable them to travel on top of deep snow. In their study of lynx winter diets in northwest Montana, Squires and others (2013) described 86 lynx kills that included 7 prey species. Snowshoe hares contributed about 96% of prey biomass while red squirrels, the second most common prey, provided only about 2% of prey biomass (Squires et al. 2006).

Across their range, lynx typically occur in boreal and subalpine coniferous forests, in landscapes with gentle topography (Squires et al. 2013). In the southern part of its range, the low densities of lynx populations are likely a result of naturally patchy habitat and lower densities of their snowshoe hare prey (Adams 1959, Griffin 2004, Koehler, Hornocker, and Hash 1979, Mills et al. 2005).

The primary limiting factor for this species appears to be suitable winter foraging habitat. Squires et al. (2010) compared lynx resource selection in summer versus winter, including lynx success in capturing snowshoe hares. During winter, lynx foraged primarily in mid- to high-elevation forests (4,134–7,726 feet) composed of mature, large diameter (greater than about 11 inches d.b.h.) trees, and selected forests with relatively denser horizontal cover, more abundant hares, and deeper snow than was available within a home range. The preferred forests had a multistory structure with dense horizontal cover provided by the young trees in the understory and conifer boughs touching the snow surface, which could support snowshoe hare populations at varying snow depths throughout the winter. Engelmann spruce and subalpine fir were the dominant tree species in forests used by lynx, but these forests contained a mix of other conifer species including lodgepole pine, western larch, and Douglas-fir.

During the summer months, lynx in Montana broadened their habitat use to include early successional forest with dense horizontal cover provided by abundant shrubs, spruce and fir saplings, and small diameter trees {Squires et al. 2010). Lynx used slightly higher elevations during the summer, but as in winter, were located below the alpine zone and above the low-elevation, dry forests dominated by ponderosa pine.

Snowshoe hare abundance is positively associated with dense horizontal cover (Hodges 2000). In western Montana, Griffin and Mills (2007) found the highest snowshoe hare densities in regenerating conifer stands that had a high density of saplings (defined as more than 2,267 stems/acre), and in mature multi-story conifer stands that had abundant saplings. Hare abundance was strongly negatively affected on stands treated with standard precommercial thinning prescriptions, which reduced stem densities to about 263-526 stems/acre (Griffin and Mills 2007). Snowshoe hare abundance in control stands was comparable to thinned stands in which 20% of the pre-commercially thinned stand was retained in uncut 0.6 acre patches (Griffin and Mills 2007). Young regenerating stands (20-40 years old) can support high densities of snowshoe hares, before growing into a structure that no longer provides the needed dense horizontal cover. A regular influx of the early stand initiation stage (created by fire, windthrow, vegetation management, or other disturbance processes) can help to enhance snowshoe hare production.

At a landscape scale, a mosaic of forest structure, from young regeneration to mature multi-story stands across the landscape is recommended to provide for the habitat needs of lynx (Interagency Lynx Biology Team 2013). Kosterman (2015) studied the studied the relationship between female lynx reproductive success and habitat composition and arrangement within home ranges on two national forests adjacent to the Flathead (Kootenai and Lolo NFs)[6]. Connectivity of mature forest, percent composition of young regenerating forest, low perimeter-area ratio of young regenerating forest patches, and adjacency of mature to young regenerating forest types were the most important predictors for overall lynx reproductive success in her study areas.

[6] See alternatives considered but eliminated from detailed study for additional information on applicability of Kosterman thesis to changes in lynx management direction.

Lynx dens in northwest Montana are typically found in multi-story stands of spruce-fir forests with dense horizontal cover and abundant coarse woody debris. Eighty percent of dens were in mature forest stands and 13 percent in mid-seral, regenerating stands (Squires et al. 2008). Young stands that were either naturally sparse or mechanically thinned were seldom used for denning. Denning habitat is generally abundant across the coniferous forest landscape, and is not likely to be limiting for lynx (Squires et al. 2008, 2010, Squires et al. 2006).

Lynx analysis units and acres of lynx habitat on the Flathead National Forest

There are 109 lynx analysis units (see table 56) that are wholly or partially within the Flathead National Forest. These lynx analysis units encompass a total of about 2,384,000 acres on the Flathead National Forest. Within the lynx analysis units, an estimated 1,795,000 acres provide lynx habitat (planning record exhibit V-24); the remainder are low elevations lacking in deep, fluffy snow or inclusions which are not capable of producing boreal forest habitat (e.g. dry forest types, non-forest).

Under the standard LAU S1, changes to lynx analysis units may only be made if site-specific habitat information demonstrates it is needed and after review by the Regional Office. No changes have been made to lynx analysis units on the Flathead National Forest subsequent to their delineation in 2000.

Stand dynamics, past disturbances and natural range of variation

After a disturbance such as stand-replacing wildfire or regeneration harvest, forests generally develop through several structural stages described by Oliver and Larson (1996) as “stand initiation,” “stem exclusion,” “understory reinitiation,” and “old growth.” Immediately after a disturbance, the removal of live trees and shrubs means these areas are not yet able to support snowshoe hares and lynx. As vegetation regrows, the burned or harvested areas develop into summer hare habitat. During this “early stand initiation” stage, if there is sufficient horizontal cover and adjacent forest edge, lynx may forage for hares in the regenerating forests during the summer months. Then, after approximately 20 years (the typical average time for this area), the trees and some shrubs will have grown tall enough to have branches at the snow surface, and dense enough to provide winter food and cover for hares. During the next couple of decades, this later “stand initiation” phase will likely provide winter snowshoe hare habitat, depending upon the species composition and density of regenerating trees. As the trees continue to grow, the stand will move into the “stem exclusion” stage, in which the crowns close, shading out understory vegetation, and the tree branches grow out of reach of the hares. Given enough time (several to many decades) and absent another stand-replacing disturbance, within-stand competition and disturbances such as windthrow and forest pathogens usually will create canopy gaps that enable the stand to develop into the “understory reinitiation” stage and eventually the “old growth” stage. However, in the boreal forests of the northern Rocky Mountains where stand-replacing wildfire is a dominant landscape process, not all forest stands will reach the understory reinitiation or old growth stage. Instead they may burn before developing old growth characteristics or may stagnate in the stem exclusion stage.

On the Flathead National Forest, western larch, lodgepole pine, Douglas-fir, and white pine generally are the dominant tree species on boreal forest habitat types during the early and late stand initiation stage. Some areas that experience intense stand-replacing wildfire and/or repeated burns may regrow as monotypic forests of lodgepole pine. If these lodgepole pine stands are extremely dense, the trees will move quickly into stem exclusion, losing their lower live branches and eliminating seedlings and shrubs in the understory due to competition and lack of light. Some of the extremely dense lodgepole pine forests that regenerated after wildfires in 1910, 1919, and 1929 have stagnated in the stem exclusion stage and do not provide snowshoe hare or lynx habitat. In lodgepole pine stands with a more moderate tree density, shade-tolerant trees such as subalpine fir or Engelmann spruce are able to establish in the understory and eventually dominate the stand. These stands are able to develop into a multistory structure that provides snowshoe hare and lynx habitat. Examples of both scenarios exist on the Flathead National Forest.

Historically, the acreage burned by wildfires has fluctuated substantially from decade to decade on the Flathead National Forest (also see Vegetation and Fire sections of Chapter 3 and appendix 3). Many factors, including weather, climate, ignition sources, available fuels, and fire suppression efforts, interact to influence the amount of acreage burned by wildfire in a given year. During the largest fire years about a century ago, the actual area burned on the Flathead National Forest was about 140,000 acres in 1890, 432,500 acres in 1910, 150,000 acres in 1919, and 90,000 acres in 1929. From 1939 to 1987, very few acres were burned. Starting in 1988, there has been an increase in acres burned; the three largest recent fire years burned about 235,000 acres in 2003, 120,000 acres in 2008, and about 100,000 acres in 2014 (Figure 41. Forest total acres burned 1889-2015).

Existing conditions as influenced by wildfire and timber harvest

Because of the recent increase in the prevalence and extent of wildfires, about 381,336 acres (approximately 21 percent) of lynx habitat in LAUs on national forest system lands of the Flathead National Forest were burned by wildfire within the last two decades. In the subalpine zone that supports lynx habitat, wildfires are typically stand-replacing events, so the areas burned in the past 20 years will be in the early stand initiation stage, not yet providing snowshoe hare habitat in all seasons. Much of the forest that burned in the 1988 fires have developed sufficient height and density of trees and shrubs to produce winter snowshoe hare and lynx habitat; however, some stands that regenerated with extremely dense lodgepole pine stands (with 20,000-50,000 stems per acre) have already moved into the stem exclusion stage.

Since about 1950, the early stand initiation stage has also been created in lynx habitat by vegetation management activities, including timber harvest. About 30,926 acres (approximately 2 percent) of lynx habitat in LAUs was treated by regeneration harvest on national forest system lands of the Flathead National Forest from 1994-2013 (table 42). Observations of lynx suggest that, similar to wildfire, regeneration harvest units do not develop into winter habitat until about 20 years post-harvest, on average. By that time, sufficient tree and shrub growth usually has occurred that lynx begin to use the harvested stands for foraging once again. Depending upon tree density, lynx may continue to frequent stands that have mixed tree species composition for about 50 years after harvest. Tree density is affected by natural factors as well as by post-harvest treatments, such as pre-commercial thinning. Retrospective analysis of stand history (harvest prescription, fuels disposal, tree planting, precommercial thinning) is currently underway to gain a better understanding of how silvicultural practices influence lynx habitat use, as determined using previously-collected telemetry locations of lynx.

Under standard VEG S2, no more than 15 percent of lynx habitat on NFS lands can be regenerated by timber management projects within a lynx analysis unit in a ten-year period (except in the wildland-urban interface, as discussed in the following section). Since the Flathead Forest Plan was amended in 2007, none of the LAUs has had more than 15% regenerated by timber harvest. In fact, on the Flathead National Forest, only 10 of the 109 lynx analysis units having had more than 5 percent of the lynx habitat acres regenerated over a 20-year period (table 56).

As of 2015, there were 25 lynx analysis units on the Flathead National Forest (highlighted in gray in table 56) that have more than 30% of lynx habitat in an early stand initiation condition as a result of recent stand-replacing wildfires and regeneration timber harvest. Wildfire was clearly the driver in creating substantial acreages in a currently unsuitable (early stand initiation) condition (table 56). Under standard VEG S1, if more than 30% of the lynx habitat in an LAU is currently in a stand initiation structural stage that does not yet provide winter snowshoe hare habitat, no additional lynx habitat may be regenerated by vegetation management projects (except in the wildland-urban interface, as discussed in the following section).

Table 55. Existing conditions of lynx analysis units (LAU) on the Flathead National Forest with regard to: acres of lynx habitat on NFS land, percent affected by stand-replacing wildfire during the previous 20-year period, percent affected by regeneration harvest during the previous 20-year period, and percent of lynx habitat that occurs within the wildland urban interface (wildland-urban interface).

Lynx Analysis Unit	Percent of NFS land in the LAU	Acres of lynx habitat on NFS land	Percent of lynx habitat affected by wildfire 1996-2015[a]	Percent of lynx habitat affected by regeneration harvest 1994-2013[b]	Percent of lynx habitat in wildland-urban interface
Canyon	96%	23,578	45%	3%	16%
Hay	90%	22,318	None	None	11%
Lakalaho	100%	21,148	<0.5%	None	18%
Lower Big	99%	18,543	93%	<0.5%	9%
Lower Coal	53%	13,968	58%	None	17%
Lower Whale	94%	18,341	27%	3%	22%
Moose	82%	11,102	None	1%	48%
North Trail	85%	26,722	1%	<0.5%	25%
Red Meadow	87%	21,956	None	None	27%
South Trail Tepee	93%	20,236	76%	3%	40%
Teakettle	59%	6,868	1%	None	70%
Upper Big	98%	18,039	24%	None	None
Upper Coal	93%	23,894	7%	<0.5%	None
Upper Trail	100%	15,404	None	None	None
Upper Whale	100%	21,775	<0.5%	None	None
Bear Creek	96%	21,039	28%	<0.5%	52%
Challenge Granite	100%	17,419	18%	None	None
Clayton Anna	100%	16,183	66%	4%	None
Coram Abbot	84%	6,653	none	None	37%
Dirtyface Spruce	100%	13,023	5%	None	6%
Doris Creek	100%	24,118	24%	3%	9%
Emery Creek	100%	12,844	None	1%	2%
Essex Java	99%	14,052	15%	None	29%
Felix Logan	100%	17,471	13%	None	None
Graves Forest	100%	21,221	8%	None	<0.5%
Hungry Horse Creek	100%	11,537	None	None	None
Lake Five	58%	2,745	None	None	99%
Long Cy	100%	21,494	23%	None	none
Moccasin Nyack	92%	13,427	2%	<0.5%	64%

Lynx Analysis Unit	Percent of NFS land in the LAU	Acres of lynx habitat on NFS land	Percent of lynx habitat affected by wildfire 1996-2015[a]	Percent of lynx habitat affected by regeneration harvest 1994-2013[b]	Percent of lynx habitat in wildland-urban interface
Murray Canyon	100%	12,625	None	<0.5%	None
Paola Ridge	92%	9,534	<0.5%	1%	48%
Slippery Bill	100%	12,587	14%	None	None
South Firefighter	100%	10,726	None	2%	None
Stanton Grant	95%	16,800	None	<0.5%	51%
Vinegar Moose	100%	21,481	10%	None	4%
West Columbia	87%	7,851	None	None	86%
Wheeler Creek	100%	15,087	None	None	14%
Wildcat Mountain	100%	15,831	20%	2%	None
Albino Necklace	99%	14,269	13%	None	None
Babcock Creek	100%	11,665	8%	None	None
Bent Whitcomb	100%	21,268	63%	1%	4%
Big Prairie Cayuse	100%	11,042	49%	None	None
Big Salmon Lake	97%	22,216	46%	None	None
Black Bear Helen	100%	14,766	79%	None	None
Bunker Creek	100%	23,273	45%	<0.5%	None
Cox Creek	100%	19,936	4%	None	None
Dolly Varden Creek	100%	24,864	14%	None	None
Dryad Miner	99%	16,882	<0.5%	None	None
Foolhen Danaher	100%	25,440	10%	None	None
Holbrook Bartlett	100%	29,119	47%	None	None
Hungry Picture	100%	18,561	30%	None	None
Kah Soldier	100%	15,288	9%	<0.5%	8%
Little Salmon Creek	100%	27,766	11%	None	None
Lodgepole Creek	100%	21,319	4%	None	None
Lost Jack Mid	100%	13,182	91%	None	None

Lynx Analysis Unit	Percent of NFS land in the LAU	Acres of lynx habitat on NFS land	Percent of lynx habitat affected by wildfire 1996-2015[a]	Percent of lynx habitat affected by regeneration harvest 1994-2013[b]	Percent of lynx habitat in wildland-urban interface
Lower Gordon Creek	100%	15,795	42%	None	None
Lower White River	100%	17,902	38%	None	None
Lower Youngs Creek	100%	18,885	50%	None	None
Mud Lake	100%	10,488	62%	None	None
Pale Clack	100%	13,956	3%	None	None
Peters Crossover	100%	17,925	None	None	None
Quintonkon Creek	100%	15,888	7%	<0.5%	2%
Rapid Basin	100%	29,821	25%	None	None
Shadow Dean	100%	27,399	24%	None	None
Silvertip Creek	100%	12,540	35%	None	None
Spotted Bear Mountain	100%	20,943	53%	<0.5%	1%
Stadium Gorge	100%	25,091	13%	None	None
Stony Jungle	100%	17,700	61%	1%	3%
Strawberry Creek	100%	16,688	27%	None	None
Sullivan Creek	100%	27,743	16%	1%	None
Three Sisters Bungalow	100%	27,654	18%	None	None
Trail Bowl	100%	24,727	78%	None	None
Twin Creek	100%	18,890	5%	<0.5%	<0.5%
Upper Gordon Creek	99%	12,638	5%	None	None
Upper White River	100%	12,521	24%	None	None
Upper Youngs Creek	100%	26,021	59%	None	None
Blacktail	79%	13,680	<0.5%	2%	80%
Haskill Mount	76%	7,885	None	5%	37%
Bond	82%	10,903	None	None	37%
Buck	68%	9,854	16%	None	61%
Elk	77%	18,879	7%	6%	29%
Glacier	92%	21,066	40%	6%	20%

Lynx Analysis Unit	Percent of NFS land in the LAU	Acres of lynx habitat on NFS land	Percent of lynx habitat affected by wildfire 1996-2015[a]	Percent of lynx habitat affected by regeneration harvest 1994-2013[b]	Percent of lynx habitat in wildland-urban interface
Holland	81%	8,294	None	3%	53%
Krause	85%	13,308	<0.5%	None	50%
Lion	98%	10,950	<0.5%	5%	None
Lost	78%	12,365	12%	None	<0.5%
Lower Beaver	86%	16,661	<0.5%	11%	39%
Meadow	87%	7,248	41%	5%	4%
North Crane	78%	10,258	None	2%	65%
Piper	91%	18,696	<0.5%	10%	15%
Porcupine	63%	8,087	None	None	1%
Schmidt	83%	9,677	None	None	52%
Soup	18%	2,351	None	None	None
South Cold	93%	17,989	<0.5%	2%	13%
South Crane	97%	13,938	None	3%	36%
South Woodward	94%	13,370	1%	4%	8%
Squeezer	51%	10,759	2%	1%	None
Upper Beaver	96%	10,684	<0.5%	<0.5%	<0.5%
Woodward	21%	3,743	None	1%	1%
Ashley Herrig	30%	6,660	None	1%	87%
Evers Reid	73%	9,586	<0.5%	10%	82%
Lost Tally	89%	9,590	None	6%	99%
Lower Good	84%	19,746	<0.5%	6%	56%
Lower Griffin	93%	17,622	57%	17%	25%
Martin Stillwater	90%	15,804	None	5%	16%
Sheppard	94%	21,352	80%	17%	22%
Upper Good	98%	28,384	15%	13%	23%
Upper Griffin	81%	15,844	5%	2%	1%
Upper Logan	80%	17,893	<0.5%	12%	15%

a-acres burned by wildfire may include areas with previous regeneration harvest so wildfire and regeneration percentages are not additive.These percentages are based forest scale data and are verified at project level.

b-based on USFS FACTS database, which does not include decisions not yet implemented. For inclusion of decisions not yet implemented see table 46.

Fuels treatments and precommercial thinning in lynx habitat

Standards VEG S1, VEG S2, VEG S5 and VEG S6 include an exemption for fuels treatments in lynx habitat within the wildland urban interface. Such fuels treatments may not occur on more than 6 percent of lynx habitat on each national forest, which is a limit of 103, 800 acres on the Flathead National Forest.

VEG S5 and VEG S6 contain several exceptions that allow for precommercial thinning in lynx habitat to meet other resource objectives. The estimated acres of precommercial thinning that possibly would be treated are shown in Appendix K of the FEIS for the Northern Rockies Lynx Management Direction. For the Flathead National Forest, the estimated acres to be thinned under the exceptions to the vegetation standards was 1,460 acres over a 10-year period (less than 0.1 percent of the lynx habitat on the Forest). The estimates were distributed as 500 acres for defensible space, 220 acres for research studies and genetic tree testing, and 740 acres for daylight thinning of western white pine. It was noted throughout Appendix K that the acreages for precommercial thinning exceptions were only estimates and may change due to changing needs.

In its biological opinion on the Northern Rockies Lynx Management Direction, the USFWS concluded that there was potential for incidental take to occur in occupied lynx habitat, mostly due to the exemptions and exceptions to the vegetation standards, which could diminish the value of lynx habitat and thereby impair feeding and reproduction by adult female lynx and survival of kittens. Because of the difficulty of detecting incidental take of lynx, USFWS used the total estimated acreage of the exemptions and exceptions as a surrogate measure for the number of lynx harmed. The amount of incidental take thus was anticipated to be represented by fuels treatments on up to 6 percent (729,000 acres) of lynx habitat across the entire Northern Rockies analysis area over 10 years, and precommercial thinning for other resource benefits on up to 64,320 acres (less than 0.5 percent) of snowshoe hare habitat (lynx foraging habitat) over a 10-year period. The USFWS provided reasonable and prudent measures and terms and conditions in order to minimize the incidental take.

Annual monitoring and reporting is a requirement of the biological opinion, in order to assure that the level of incidental take is not exceeded. The actual acres with decisions for treatments using wildland-urban interface exemptions on the Forest was a little over 9,000 acres as of October 2015 (table 57). During the same period, the Flathead National Forest had decisions for precommercial thinning under the exceptions for 929 acres (table 57). The vast majority of thinning completed under the exceptions was for western white pine (898 acres), in which 80 percent of the winter snowshoe hare habitat was retained as required by the standard. The allowable level of incidental take has not been exceeded for the Northern Rockies analysis area or for the Flathead National Forest.

Table 56. Acres of lynx habitat on the Flathead National Forest treated with exceptions and exemptions to the forest plan vegetation standards (decisions from 2007 to October 2015).

Habitat	Estimated acres in the 2007 FEIS	Sum of acres with decisions for treatment
Lynx habitat outside the wildland-urban interface with decisions for precommercial thinning using the exceptions	1,460 (over 10 years)	929 (2007-2015)
Lynx habitat inside the wildland-urban interface with decisions for treatments using the fuels reduction exemption	103,800 (cumulative)	9,191 (2007-2015)

Existing conditions in relation to winter recreation

In the past, some researchers have speculated that packed trails could serve as travel routes that might enable competing predators (e.g., coyotes) to access snowshoe hare prey in lynx habitat (Murray and Boutin 1991, Murray et al. 1994, Buskirk et al. 1999). However, in its remanded determination (Federal Register vol. 68, no. 128, pp. 40076-40101, July 3, 2003), USFWS found no evidence for competition between lynx and other predators such as coyotes, or if competition exists, that it exerts a population-level impact on lynx, and therefore did not consider this to be a threat to lynx. Additionally, Kolbe et al. (2007) completed a study of the effect of snowmobile trails on coyote movements in lynx habitat in northwestern Montana. They reported that coyotes in their study area were primarily scavengers in winter (snowshoe hare kills composed only 3% of coyote feed sites). Furthermore, coyotes did not forage closer to compacted snowmobile trails than random expectation, and the overall influence of snowmobile trails on coyote movements and foraging success appeared to be minimal.

However, because snow compaction results varied across the 18 national forests encompassed by the NRLMD, Guideline HU G11 specified that designated over-the-snow routes or designated play areas should not be expanded outside baseline areas of consistent snow compaction, unless designation serves to consolidate use and improve lynx habitat. Each national forest was expected to map and update its baseline of areas that have consistent snow compaction.

In November 2006, the Flathead National Forest issued a decision for a motorized winter recreation plan, also known as amendment 24 to the forest plan. Developed with consideration of the terms of a settlement agreement, the decision clarified where, when, and under what conditions over-snow vehicles are allowable on the Flathead National Forest. The specific areas and routes that are suitable for motorized over-snow vehicle use are identified on maps, which were incorporated into the forest plan. Under this decision, about 68% of the Forest's lynx habitat has been closed to motorized over-snow vehicle use throughout the past decade. About 19% of the Forest is open to motorized over-snow use from Dec 1 to March 31 only, about 10% is open year-long (snow conditions permitting), and about 2% is open December 1 to April or May (known as late-season areas)..

Lynx population and habitat connectivity

Possible lynx linkage areas have been identified to assist in land use planning (Claar et al. 2003). These linkage areas are intended to allow for movement of animals between blocks of habitat that are otherwise separated by intervening non-habitat areas such as basins, valleys, and agricultural lands, or to maintain habitat connectivity where habitat naturally narrows due to topographic features. Several linkage areas that intersect the Flathead National Forest were identified in the Northern Rockies Lynx Management Direction FEIS, figure 1-1.

Subsequently, Squires and others (2013) identified lynx travel corridors connecting Canada and northwest Montana using least-cost path modeling. A primary corridor was identified that extended from the Whitefish Range in the north, along the western front of the Swan Range and ended near Seeley Lake, Montana. A second modeled corridor extended along the east side of Glacier National Park southward through the Bob Marshall Wilderness Complex.

The availability of forest cover is beneficial in facilitating lynx movement, while human developments, such as interstate highways or broad expanses of agricultural lands without cover, may deter lynx movements. State Highway 83 bisects the Swan Valley, but radio-collared lynx have been documented to cross this highway and it does not appear to impede their movements (Squires and Laurion 1999). Radio-collared lynx have also been documented crossing State Highway 2 between the Flathead National Forest and Glacier National Park (Squires 2013 unpublished data).

Environmental consequences - Canada lynx

Features common to all alternatives

All of the alternatives would retain the existing forest plan objectives, standards and guidelines for the conservation of lynx (appendix F) except for two changes that are proposed under the action alternatives.

Under all alternatives, one objective, one standard and one guideline apply to all management projects in lynx habitat in lynx analysis units in occupied habitat and in linkage areas, except for wildfire suppression or wildland fire use. Objective ALL O1 encourages maintaining or restoring lynx habitat connectivity within and between lynx analysis units, and in linkage areas. Standard ALL S1 specifies that new or expanded permanent developments and vegetation management projects must maintain habitat connectivity in a lynx analysis unit and/or linkage area. Guideline ALL G1 says that methods that avoid or reduce effects on lynx should be used when constructing or reconstructing highways or forest highways across federal land.

Under all of the alternatives, the estimated acres of precommercial thinning that would be allowed under the exceptions to vegetation standards VEG S5 and VEG S6 would be updated. An update is needed to reflect the expected 15-year life of the revised forest plan, as well as an updated assessment of treatments needs under the action alternatives. The Forest will consult with the USFWS on updated exception acres.

Alternative A - no action alternative

This alternative reflects the 1986 forest plan, as amended. The forest plan was amended in 2007 to add objectives, standards and guidelines that addressed the major threats to lynx and remedied the inadequacy of existing regulatory mechanisms. Under alternative A, there would be no change to any of the plan components for lynx. The effects to lynx that were described in the 2007 FEIS (Volumes 1 and 2), biological assessment, biological opinion and Record of Decision for the Northern Rockies Lynx Management Direction are incorporated by reference.

Under alternative A, the Flathead National Forest's estimated acreages for the fuels treatment exemptions and the exceptions to the vegetation standards, which were originally estimated for the period 2007-2016, would be carried forward unchanged through the anticipated life of the revised forest plan (15 years following approval). Under alternative A, the estimate of the acres to be thinned under the VEG S5 and VEG S6 exceptions is adjusted (from 1,460 acres over a 10-year period) to 2,190 acres over a 15-year period.

The following further describes the existing forest plan components and whether there is any new information or changed circumstances relative to the effects on lynx. Analysis is presented for each of the anthropogenic influences identified in the 2013 Lynx Conservation Assessment and Strategy.

Vegetation management

Objectives VEG O1, VEG O2, and VEG O4 encourage management of vegetation to mimic or approximate natural succession and disturbance processes while maintaining lynx habitat components; providing a mosaic of habitat conditions through time that support dense horizontal cover and high densities of snowshoe hare, with winter snowshoe hare habitat provided by the stand initiation stage and by mature multistory conifer vegetation; and focusing vegetation management in areas that have the potential to improve winter snowshoe hare habitat, but presently have poorly developed understories that lack dense horizontal cover. Under this alternative, projects would be designed to meet these objectives, which will benefit lynx by creating or sustaining desired habitat conditions.

Standard ALL S1 requires that new or expanded permanent developments and vegetation management projects maintain habitat connectivity in a lynx analysis unit and/or linkage area. Under this alternative, connectivity would be maintained, which would be beneficial to lynx.

Standard VEG S1 allows no additional regeneration harvest by vegetation management projects if more than 30 percent of the lynx habitat in lynx analysis unit is currently in a stand initiation structural stage that does not yet provide winter snowshoe hare habitat. Fuels treatments within the wildland urban interface that do not meet the vegetation standards may occur on no more than 6 percent cumulatively on each national forest, and may not result in more than 3 adjacent lynx analysis units exceeding the standard. As a result of recent large wildfires, currently 25 of the 109 lynx analysis units on the Forest exceed the 30 percent threshold (table 45). Precluding further regeneration harvest in these lynx analysis units until vegetation regrows into winter snowshoe hare habitat will help to support lynx by maintaining a mosaic of habitat, as called for under VEG O2, so that a lynx is more likely to be able to access sufficient prey resources within its home range.

Standard VEG S2 does not allow timber management projects to regenerate more than 15 percent of lynx habitat on National Forest System lands within a lynx analysis unit in a ten-year period. Fuels treatments within the wildland urban interface that do not meet this standard may occur on no more than 6 percent cumulatively on each national forest. None of the lynx analysis units on the Flathead National Forest exceed this standard (table 45), nor would that occur in the future under the forest plan. This standard would help to maintain a mosaic of habitat over time, as called for under VEG O2, which would benefit lynx by providing a good distribution of prey resources across the landscape.

Standard VEG S5 generally precludes pre-commercial thinning projects from occurring during the stand initiation structural stage until the stand no longer provides winter snowshoe hare habitat. The intent is to maintain the habitat conditions that are expected to produce high densities of snowshoe hares, which will contribute to sustaining the lynx population. Fuels treatments within the wildland urban interface that do not meet the vegetation standards may occur on no more than 6 percent cumulatively on each national forest, and may not result in more than 3 adjacent lynx analysis units exceeding the standard. There are six exceptions to the standard VEG S5 that could be used to meet other resource objectives.

The six exceptions to standard VEG S5 are as follows: 1) within 200 feet of administrative sites, dwellings or outbuildings to provide defensible space; 2) for research studies or genetic tree tests; 3) based on new, peer-reviewed information demonstrating that a project is not likely to affect lynx or would have short-term adverse effects but long-term beneficial effects; 4) for conifer removal or daylight thinning where aspen is in decline; 5) for daylight thinning of rust-resistant western white pine; or 6) to restore whitebark pine. Exceptions 2 through 6 may only be utilized in lynx analysis units where Standard VEG S1 is met. The overall effects of the VEG S5 exceptions on lynx across the Northern Rockies analysis area, as summarized in the 2007 Record of Decision, were as follows. Few acres would be precommercially thinned at administrative sites and for research and genetic tests, and these would generally be benign with little or no adverse effect on lynx. Thinning to enhance whitebark pine and aspen would benefit other wildlife species, and would occur on a limited number of acres of lynx habitat, resulting in a minor adverse effect on lynx. Daylight thinning would be allowed around individual planted rust-resistant western white pine in a manner that retains 80 percent of the winter snowshoe hare habitat. This may reduce lynx habitat effectiveness, but since this tree species has declined by 95 percent across its range, it was decided that a limited amount of thinning should be allowed to maintain western white pine on the landscape. The total amount of precommercial thinning allowed under these exceptions across the entire Northern Rockies analysis area could potentially affect about 64,000 acres, which represents less than 0.5 percent of all lynx habitat and less than 2 percent of winter snowshoe hare habitat in the Northern Rockies.

On the Flathead National Forest, the acres of precommercial thinning allowed under the exceptions would be held constant (2,190 acres over 15 years, which represents less than 0.1 percent of lynx habitat on the Forest). Precommercial thinning under the exceptions could degrade snowshoe hare and lynx habitat. However, the limitations on the acreage and circumstances where the exceptions could be used makes it very unlikely that there would be a measurable adverse effect on lynx.

Standard VEG S6 precludes all vegetation management activities that would reduce winter snowshoe hare habitat in multistory forests. Fuels treatments within the wildland urban interface that do not meet the vegetation standards may occur on no more than 6 percent cumulatively on each national forest. Research in northwest Montana demonstrated that mature multistory forests provide important snowshoe hare habitat and are more important to lynx than younger stands during the critical winter period (Squires et al.

2010). Timber harvest would be allowed in areas that have the potential to improve winter snowshoe hare habitat but presently have poorly developed understories. Implementation of this standard is expected to benefit lynx by retaining and developing important winter habitat. There are three exceptions to standard VEG S6: 1) to accommodate fuels reduction activities within 200 feet of administrative sites, dwellings, outbuildings, recreation sites, and special use permit improvements, including infrastructure within permitted ski area boundaries, to provide defensible space; 2) for research studies or genetic tree tests; and 3) for incidental removal during salvage harvest (e.g. removal due to location of skid trails). Exceptions 2 and 3 can only be used in lynx analysis units where Standard VEG S1 is met. The exceptions to VEG S6 were anticipated to result in the loss of lynx foraging habitat in some treated multistory stands, which could have an adverse effect on lynx survival and reproduction by reducing prey resources. However, it was expected that an insignificant number of acres would be affected under the exceptions. Standard VEG S6 would remain the same under this alternative and the effects on the Flathead National Forest would continue to be minor or undetectable.

In recognition of the escalating monetary and societal costs associated with fires in the wildland urban interface, fuels treatment projects in the wildland urban interface are exempted from compliance with VEG S1, VEG S2, VEG S5, and VEG S6. However, these treatments are constrained to no more than 6 percent (cumulatively) of lynx habitat on an individual National Forest. In addition, fuel treatment projects may not result in more than three adjacent lynx analysis units exceeding standard VEG S1. Guideline VEG G10 encourages consideration of VEG S1, VEG S2, VEG S5, and VEG S6 when designing projects, in order to promote lynx conservation.

The wildland urban interface (see glossary), is defined by the Healthy Forests Restoration Act. The wildland urban interface is an area within or adjacent to an at-risk community that is identified in a community wildfire protection plan, or that is a certain distance around the community if a community protection plan is not available. For analysis purposes, the wildland urban interface was modeled in 2007 as a 1-mile buffer surrounding communities with more than 28 people/mi^2. Over the entire Northern Rockies analysis area, about 6 percent of lynx habitat was found to be within 1 mile of communities. For the Flathead National Forest, a total of about 247,000 acres were estimated to fall within the 1-mile buffer, of which 131,800 acres were within lynx habitat (or about 7.6 percent of the total amount of lynx habitat on the Flathead National Forest). The exemption for vegetation treatments within the wildland urban interface is limited to no more than 6 percent of lynx habitat on each national forest, which is 103,800 acres for the Flathead National Forest.

In its biological opinion, USFWS assumed that fuel treatments within the wildland urban interface would be distributed throughout a national forest and not excessively concentrated in adjacent lynx analysis units. It was expected that fuel treatments in the wildland urban interface would remove dense horizontal cover and the intent would be to maintain lower tree density in these areas. On the Flathead National Forest, 48 of the 109 lynx analysis units (44 percent) do not contain any identified wildland urban interface; these are mostly located within the Bob Marshall Wilderness Complex. The Salish Mountains Geographic Area has the highest percentage of lynx habitat in the wildland urban interface (ranging from 1 to 99 percent of individual lynx analysis units), followed by the North Fork Flathead River (ranging from 9 to 70 percent) and the Swan Valley Geographic Area (ranging from 0 to 61 percent). Standard VEG S1 prevents cumulative impacts to lynx habitat, because wildland-urban interface treatments are not allowed to cause three adjacent lynx analysis units to exceed 30 percent currently in a stand initiation structural stage that does not yet provide winter snowshoe hare habitat. Furthermore, much of the wildland urban interface occurs at lower elevations (i.e., near the lower edge of lynx habitat) and therefore is less likely to be the highest quality lynx habitat (Squires et al. 2013), reducing the potential for adverse effects. During the period 2007-2015, the Flathead National Forest used the exemption to treat fuels on 9,191 acres of lynx habitat within the wildland urban interface, or about 9% of the limit allowed under the incidental take statement.

Under this alternative, the 103,800 acre cap would be carried forward. As previously discussed, fuels treatments in the wildland urban interface will have some adverse effects on lynx and their snowshoe hare prey, but the limitations on the extent and distribution of these projects will limit the impacts on lynx.

Guideline G1 encourages development of projects that are designed to recruit a high density of conifers, hardwoods, and shrubs where such habitat is scarce or not available. Guideline VEG G5 is to provide habitat for alternative prey species, particularly red squirrel, in each lynx analysis unit. Guideline VEG G10 states that all the vegetation standards should be considered when designing fuel treatment projects within the wildland-urban interface to promote lynx conservation. Guideline VEG G11 states that denning habitat should be distributed in each lynx analysis unit. These guidelines benefit lynx by encouraging management that creates or maintains lynx habitat components, and they would continue to be considered in the site-specific design of projects under this alternative.

Wildland fire management

Objective VEG O3 encourages fire use activities that restore ecological processes and maintain or improve lynx habitat. Under guideline VEG G4, prescribed fire activities should not create permanent travel routes that facilitate snow compaction, and permanent firebreaks should not be constructed on ridges or saddles.

Historically, fire has played a significant role in creating forested landscape patterns on the Flathead National Forest and continues to do so, as expected. Most of the boreal forest zone where lynx habitat occurs has not been strongly influenced by past fire suppression efforts, since these areas naturally burn infrequently. Since the late 1980's, the Forest has experienced an increase in the number of large, stand-replacing wildfires (see Vegetation and Fire sections of DEIS chapter 3 for more details). This is resulting in a spike in the amount of lynx habitat that is currently in a temporarily unsuitable condition. By the expected end of the life of the revised forest plan (about 15 years after adoption) a substantial portion of these cohorts will have developed sufficient height and density to provide dense horizontal cover of branches at the snow surface for snowshoe hare habitat.

Fragmentation of habitat

Objective LINK O1 encourages working with landowners to pursue conservation easements, habitat conservation plans, land exchanges, or other solutions in mixed ownership areas to reduce the potential of adverse impacts on lynx and lynx habitat. Standard ALL S1 requires that new or expanded permanent developments and vegetation management projects in a lynx analysis unit and/or a linkage area must maintain habitat connectivity. In linkage areas, potential highway crossings will be identified (LINK S1), Forest Service lands should be retained in public ownership (LINK G1). Guideline HU G6 says that methods to avoid or reduce the effects on lynx in lynx habitat should be used when upgrading unpaved roads to maintenance levels 4 or 5, if the result would be increased traffic speeds and volumes, or a foreseeable contribution to increases in human activity or development in lynx habitat.

Many actions that fragment habitat, such as highway expansions and residential developments, are not under the authority of the Forest Service. However, the forest plan components listed above are beneficial in maintaining or improving habitat connectivity on National Forest System lands, and would help to reduce or minimize adverse effects.

Recreation

Objective HU O1 discourages the expansion of snow-compacting activities in lynx habitat; HU O2 says to manage recreational activities to maintain lynx habitat and connectivity; HU O3 encourages concentrating activities in existing developed areas; and HU O4 says to provide for lynx habitat needs and connectivity when developing or expanding existing developed recreation sites or ski areas. No standards were adopted, because recreational activities were not considered to be a threat to the population of lynx. Two guidelines were included that address ski area development or expansion: HU G1 says that provisions should be made for inter-trail islands that maintain winter snowshoe hare habitat and HU G2 encourages providing foraging habitat, consistent with the ski area's operational needs. Guideline HU G3 says that recreation development and operations should be planned to provide for lynx movement and maintain the effectiveness of lynx habitat. Guideline HU G11 states that designated over-the-snow routes or designated play areas should not expand outside baseline areas of consistent snow compaction, unless designation serves to consolidate use and improve lynx habitat, within a LAU or a combination of immediately adjacent LAUs.

Downhill ski resorts typically occur at high elevations in areas with coniferous forests and deep snow, which coincides with lynx habitat. On the Flathead National Forest, two ski resorts, Whitefish Mountain Resort (formerly known as Big Mountain Resort) and Blacktail Mountain Resort contain lynx habitat, each located within one lynx analysis unit. In a 2000 consultation for 12 ski resorts in Montana, including Big Mountain and Blacktail Mountain Resorts, existing conditions, proposed expansions and ongoing operations were determined to be likely to adversely affect lynx. However, given the limited proportions of the lynx analysis units affected and other factors, USFWS concluded that ongoing and proposed actions were not likely to jeopardize the species, nor to result in incidental take of individual lynx. The 2007 biological opinion on the Northern Rockies Lynx Management Direction re-confirmed the conclusion that individual lynx may be adversely affected through habitat avoidance, alteration or loss, but that the total area affected is limited and the objectives, standards and guidelines would reduce the potential impacts. Under this alternative, the two ski resorts will continue to operate within their existing permit area boundaries (see Recreation section of Chapter 3 for more details).

Under amendment 24, specific routes and areas were designated as suitable or not suitable for over-snow motorized vehicles. About 68 percent of the lynx habitat on the Flathead National Forest is closed to motorized over-snow vehicle use (see figures 1-44 to 47, mapped lynx habitat with over-snow vehicle use). Lynx are well-distributed across the forest, including areas such as Big Creek and Skyland Creek that receive substantial use by snowmobiles. As discussed previously, Kolbe et al. (2007) found that compacted trails from over-snow motorized vehicles in their study area (western Montana) had only minimal impacts on coyote movements and foraging success, and that snowshoe hares were an insignificant portion of the winter diet of coyotes, indicating that snow compaction did not promote a competitive interaction between coyotes and lynx. Mountain lions are a known source of mortality of lynx, accounting for roughly one-third of documented mortalities in northwest Montana study areas, but all documented mountain lion predation on lynx occurred in the snow-free period (J.Squires, pers. comm. 4/13/2016, planning record exhibit V-39). Over-snow vehicles provide access for trapping, which has the potential to increase the risk of incidental trapping of lynx. Overall, the level and distribution of winter recreation under this alternative is not likely to negatively impact the overall lynx population, although it is possible that this activity could increase somewhat the risk of disturbance or mortality to individual lynx.

Mineral and energy activities

Objective HU O5 says to manage human activities, including minerals and oil and gas exploration and development, to reduce impacts to lynx and lynx habitat. Guideline HU G4 encourages remote monitoring of mineral and energy development sites and facilities to reduce snow compaction; guideline HU G5 addresses development of a reclamation plan to restore lynx habitat when mineral and energy development sites and facilities are closed. HU G12 limits winter access for non-recreation special uses and mineral and energy exploration and development to designated routes or designated over-the-snow routes. The application of these measures is expected to minimize adverse effects on lynx.

At the present time, there is little exploration and development activity occurring on the Flathead National Forest. Existing oil and gas leases were suspended and would require further NEPA analysis and decision-making before any activity could occur. The FEIS for the Northern Rockies Lynx Management Direction anticipated no or little effect on lynx related to mineral and energy activities, which would continue to be the case under this alternative (see Minerals and Energy section of Chapter 3 for more details).

Forest/backcountry roads

There are four forest plan guidelines concerning forest roads: HU G6 is to use methods that avoid or reduce effects on lynx when upgrading unpaved roads to maintenance levels 4 or 5, if the result would be increased traffic speeds and volumes, or a foreseeable contribution to increases in human activity or development; HU G7 discourages building new permanent roads on ridge-tops, saddles and forested stringers, or in areas identified as important for lynx habitat connectivity; HU G8 says that brush-cutting along low-speed, low-traffic-volume roads should be done to the minimum level necessary to provide for public safety; and HU G9 says that public motorized use should be restricted on new roads built for projects. These objectives and guidelines would continue to limit the potential local impacts of roads on lynx and lynx habitat.

On the Forest, implementation of Amendment 19 has resulted in decreased road mileage, decreased road maintenance, and many miles of public road use restrictions in the last decade, reducing any potential risks to lynx associated with public road access (see Infrastructure, Recreation, and Grizzly Bear sections of Chapter 3 for more details).

Livestock grazing

The forest plan includes one objective and four guidelines concerning livestock grazing in lynx habitat. Objective GRAZ O1 is to manage livestock grazing to be compatible with improving or maintaining lynx habitat. Guideline GRAZ G1 is to manage livestock grazing in fire- and harvest-created openings so that regeneration of shrubs and trees is not prevented; under GRAZ G2, livestock grazing in aspen stands should be managed to contribute to the long-term health and sustainability of aspen; under GRAZ G3, livestock grazing in riparian areas and willow carrs should be managed to contribute to maintaining or achieving a preponderance of mid- or late-seral stages; and under GRAZ G4, livestock grazing in shrub-steppe habitats that are in the elevation ranges of forested lynx habitat in LAUs should be managed to contribute to maintaining or achieving a preponderance of mid- or late-seral stages. With these components in place, the effect of livestock grazing on lynx and lynx habitat was judged to be minimal across the Northern Rockies analysis area. Very little livestock grazing occurs on the Flathead National Forest (see Grazing section of Chapter 3 for more details). Under this alternative, there would continue to be little or no effect on lynx attributable to livestock grazing.

Summary and conclusion for alternative A

Under this alternative, the existing forest plan would remain in place without any changes. Continued implementation of the Flathead National Forest Plan is anticipated to maintain or improve lynx habitat in the long term, although some short-term adverse effects may occur, primarily due to the reduction of snowshoe hare habitat allowed under the exemptions and exceptions to the vegetation standards. Reductions in snowshoe hare habitat due to fuels treatments and precommercial thinning could lead to lowered reproduction and survival of lynx. However, the adverse effects are limited in their extent and distribution. A maximum of 6 percent of the 1.8 million acres of lynx habitat on the Forest could be affected by the exemption for fuels reduction in the wildland-urban interface, and less than 0.1 percent of lynx habitat could be affected by the exceptions allowing precommercial thinning for other resource objectives. Except for defensible space, the exceptions may not be used in lynx analysis units that have more than 30 percent in stand initiation structural stage that does not yet provide winter snowshoe hare habitat. The forest plan direction as a whole will promote conservation of the lynx population.

Features common to the action alternatives

Under Alternatives B, C and D, the estimate for exceptions and exemptions to the vegetation standards is given as a range of acres, from 2,190 to 10,750 acres. The low end of the range reflects the acres allowed under the existing forest plan. For planning purposes, the upper end reflects potential additional treatment needs, distributed as follows: 500 acres for defensible space (VEG S5/S6 exception 1), 1,500 acres for research studies and genetic tree tests (VEG S5/S6 exception 2), 1,800 acres for conifer removal or daylight thinning of aspen (VEG S5 exception 4), 4,750 acres for daylight thinning of planted, rust-resistant western white pine (VEG S5 exception 5), and 2,200 acres to restore whitebark pine (VEG S5 exception 6). As before, the Forest anticipates that the overall acres will be constrained but that there will be flexibility as to which exception categories are used in order to respond to changing conditions and needs. This range of acres represents 0.1 to 0.6 percent of lynx habitat on the Flathead National Forest.

VEG S5 exception 3 has not been included in the acreage estimates because use of this exception first requires peer review and acceptance by the regional level of the Forest Service and state level of the Fish and Wildlife Service, with a written determination stating that modified precommercial thinning techniques would be not likely to adversely affect lynx, or would have short term negative but long term benefits to the Canada lynx or its habitat.

As a result of recent wildfires, there is a large pulse of lynx habitat in the early stand initiation stage on the Flathead National Forest (see Vegetation and Fire sections of DEIS chapter 3). It is likely that these stands will develop into good quality winter snowshoe hare habitat about 20 years after the disturbance; however, after another 20 years or so, this large cohort of forest stands then will move into the stem exclusion stage, producing little hare habitat for several decades. In addition, burned areas that have regenerated into very dense monotypic stands (with densities of 20,000-50,000 trees per acre), are likely to stagnate in the stem exclusion stage. Monitoring conducted on the Forest has shown than some of the very dense forested stands that regenerated after the 1910 wildfires have remained in a stagnated condition (with trees that are only 2-4 inches d.b.h.) for over 100 years and have not progressed to a multistory mature condition.

Recently-burned areas provide an opportunity to test modified techniques for precommercial thinning with the aim of increasing tree species diversity, promoting development and retention of dense horizontal cover over longer time periods, and shortening the time it takes for burned forests with very high densities of regenerating trees (often lodgepole pine and/or western larch) to develop into multistory mature forest with a dense understory of spruce and sub-alpine fir. The Forest Vegetation Simulator has been used to model stand structure and growth following traditional and modified precommercial thinning techniques, to predict which methods offer the most promise for providing the desired forest composition and structure to support snowshoe hares and lynx over the long term (see appendix C). These modeling results, as well as monitoring (and possibly research) of past treatments in areas with lynx telemetry data, could inform project planning and design. The Forest is actively working with research scientists to design and conduct studies that clarify the relationships between stand treatments and the effects on lynx.

Alternative B

This alternative is based on the detailed proposed action that was published with the notice of intent in March 2015, with modifications in response to comments and refinements of the management area mapping. This alternative emphasizes moving towards desired future conditions and contributing to ecological, social, and economic sustainability.

Under this alternative, the Northern Rockies Lynx Management Direction (appendix F) would be appended to the Flathead Forest Plan, with two forest-specific changes. The changes are: 1) an additional exception under VEG S6 for felling of trees within 200 feet of selected mature whitebark pine trees that are genetically resistant to disease; and 2) amended wording of guideline HU G11. The effects of each of these changes are discussed below, along with the effects of other aspects of the forest plan under this alternative.

New exception to VEG S6 for non-commercial thinning around mature whitebark pine trees

Standard VEG S5 has an exception that allows pre-commercial thinning to restore whitebark pine, but VEG S6 does not provide a comparable exception to accommodate vegetation treatments to protect whitebark pine in multistory mature stands. Under Alternatives B, C, and D, standard VEG S6 would have an additional exception that would allow non-commercial felling of trees of any size that are growing within 200 feet of disease-resistant whitebark pine trees used for cone, scion, and pollen collection. Removal of these trees would be aimed at reducing the risk of mortality of the whitebark pine trees due to wildfire, within-stand competition and other stressors, and making the trees more resilient and adaptable to changing future environments.

Whitebark pine historically was widespread on the Flathead National Forest, and resilient to losses due to wildfire, drought, insects or pathogens. However, an introduced disease, white pine blister rust, has caused extensive mortality and severe decline of the whitebark pine across its distribution on the Forest. In addition, some whitebark pine trees on the Forest are surrounded by dense forests dominated by larger subalpine fir, making whitebark pine very susceptible to being killed by wildfires. The Forest has already lost some of its remaining live whitebark pine trees of all sizes to high severity wildfire. The Flathead National Forest is an important source of whitebark pine seeds that are used for restoration of the species throughout the region (also see Chapter 3, section 3.5.1, whitebark pine).

Under the new VEG S6 exception, along with the existing exception to VEG S5 for whitebark pine restoration, it is estimated that a total of about 2,200 acres across the forest over the next 15 years would be treated with precommercial and non-commercial thinning to protect and restore whitebark pine. The acreage estimate is for the entire stand, although not all of the acres within a stand would be affected, since only trees located within 200 feet of the selected whitebark pine trees would be removed. Like the VEG S5 exceptions 2-6, this exception could only be used in lynx analysis units that meet VEG S1 (30 percent or less in early stand initiation phase). Preliminary analysis, subject to further site-specific analysis, suggests that 14 out of the 109 lynx analysis units distributed in all but the Salish Mountains geographic area (see figure 1-48, lynx analysis units on the Forest), may be affected, with no more than 2% of the lynx habitat in any one LAU containing stands of whitebark pine that may be identified for possible treatment.

Removal of the trees that surround selected mature, rust-resistant whitebark pine trees in mature multistory stands has the potential to degrade lynx and snowshoe hare habitat quality. At this time, it is not known whether the stands that would be targeted for treatment actually provide the dense horizontal cover needed by snowshoe hares, and therefore the effects on lynx are uncertain. Since the felled trees would not be removed from the site, the down logs would provide additional horizontal cover that may partially offset the adverse effects for a period of time. The potential for adverse effects would be greater in a lynx analysis unit, such as Coram or Lower Beaver, that also has a large proportion (37-39%) of their lynx habitat in the wildland urban interface. The amount and arrangement of lynx and snowshoe hare habitat in a particular lynx analysis unit would be further evaluated during site-specific analysis and decision-making. Overall, while there could be adverse effects on individual lynx, due to the limited number of acres of lynx habitat that would be treated, it is not likely that there would be a detectable impact on the lynx population as a result of this new exception category.

Acres available for over-snow vehicle use in LAUs

Northern Rockies Lynx Management Direction guideline HU G11 addresses areas of consistent snow compaction, which are defined as areas that get enough human use that individual tracks are indistinguishable. Areas such as over-snow motorized vehicle use routes, groomed cross-country ski routes, parking lots, and adjacent openings with consistently high levels of use would meet this definition. There would be no increase in routes or parking lots under any alternative.

Unlike some other national forests within the Northern Rockies, under forest plan amendment 24 (USFS 2006) the Flathead National Forest designated specific routes and areas, as well as seasons, for motorized over-snow vehicle use in accordance with §212.81 of the Travel Management Rule. This provides a more comprehensive strategy for management of over-snow motorized recreation, as compared to addressing designated routes/play areas and areas of consistent snow compaction. Under this alternative, the wording of HU G11 would be replaced to better mesh with the Forest's motorized winter recreation plan, and to address multiple wildlife species, as shown below.

Table 57. NRLMD guideline HU G11

Northern Rockies Lynx Management Direction, guideline HU G11	Flathead National Forest-specific modification of HU G11 under Alts. B and C
Designated over-the-snow routes or designated play areas should not expand outside baseline areas of consistent snow compaction, unless designation serves to consolidate use and improve lynx habitat. This is calculated on an LAU basis, or on a combination of immediately adjacent LAUs.	To maintain the quality of lynx habitat or wolverine maternal denning habitat, there should be no net increase in miles of designated motorized over-snow vehicle routes or areas where motorized over-snow vehicle use would be suitable in lynx habitat or wolverine maternal denning habitat on NFS lands at a forestwide scale. Specific locations of routes or areas suitable for motorized over-snow vehicle use are specified in figures B-03 and B-04 (forest-specific modification that replaces NRLMD guideline HU G11, appendix F).

The Whitefish Range Partnership collaborative group has requested consideration of a proposal to have a larger area where motorized over-snow vehicle use would be allowed in the area between Big Creek and Columbia Falls. In addition, other members of the public expressed a need to adjust the boundaries of certain areas that are currently open, to improve the public's ability to recognize boundaries on the ground, because some areas have grown in with vegetation and others have been burned by wildfire. Some additional changes have been suggested to assist the Forest Service in enforcing closure boundaries. Under alternative B, these suggestions have been addressed as follows.

- Additional areas would be suitable for over-snow recreation vehicle use in seven lynx analysis units: Lower Big, Upper Big, Canyon, Upper Coal, Red Meadow, Bear Creek and Challenge-Granite. In the Lower Big and Canyon lynx analysis units, there would be an increase of about 13,367 acres suitable for over-snow use (see figure 1-45, mapped lynx habitat and over-snow vehicle use), an increase of about 660 acres in the middle of an existing route in the Upper Big LAU, an increase of about 170 acres of access in Upper Coal, and an increase of about 260 acres adjacent to an existing area in Red

Meadow. There would be an increase of about 700 acres in a small area in the Bear Creek and Challenge-Granite LAUs, for a total increase of about 15,708 acres.

- The above increases would be offset by changing some areas in six different lynx analysis units to be unsuitable for motorized over-snow vehicle use. These changes would total about 21,850 acres in the Glacier, Bear Creek, Slippery Bill, Kah Soldier, Stony Jungle and Sullivan lynx analysis units. Thus for the Forest as a whole, there would be a net decrease by about 6,323 acres in the total acres designated as suitable for over-snow vehicle use.

Figures B-03 to B-05 show the areas that would be affected by changes in motorized over-snow use suitability by alternative (see DEIS Appendix B). In the lynx analysis units with an increase in acres suitable for motorized over-snow vehicle use, an increase in dispersed over-snow use would likely occur, but it is difficult to predict if openings would receive consistently high levels of use. The actual use of areas suitable for motorized over-snow use is less than the total acreage, because terrain and vegetation also influence where over-snow vehicles can physically go. Vegetation conditions are dynamic over time and change in response to disturbance and succession. Wildfire may initially open up dense forest for over-snow use, but as high densities of dead trees fall or as succession occurs, areas previously open to over-snow use become un-available because machines cannot physically maneuver between or over the trees. In vicinities that are already heavily used, such as Lower Big Creek, there is a potential for changes in suitable areas to result in an increase in areas of consistent snow compaction. In other suitable areas, this would probably not occur. Overall, the acres that are suitable for over-snow vehicle use would be decreased across the Forest as a whole under alternative B. By reducing snow compaction and disturbance, a small benefit to lynx and snowshoe hares might result.

Summary and conclusion for alternative B

Under alternative B, the Northern Rockies Lynx Management Direction would remain in place with two forest-specific changes. There would be some additional minor adverse effects from felling of trees within 200 feet of disease-resistant whitebark pine trees used for cone, scion, and pollen collection, but this would occur on very few acres of lynx habitat and likely in only about 10 lynx analysis units. In seven lynx analysis units, there would be increases in the area suitable for over-snow vehicle use, which would be offset by reductions in six other LAUs. The change to HU G11 would result in a net decrease in the area suitable for over-snow vehicle use, and a small benefit to lynx. The forest plan direction under this alternative would have slightly more potential for short-term adverse effects than alternative A, but on the whole would promote conservation of the lynx population.

Alternative C

Alternative C has more acres of recommended wilderness than the other alternatives. Desired conditions for wildlife and other resources are achieved though greater use of natural ecosystem processes, such as planned and unplanned fire ignitions. Primitive or semi-primitive non-motorized recreational opportunities are increased because motorized use and mechanized transport would not be allowable in the recommended wilderness areas.

Under this alternative, existing Flathead Forest Plan direction for lynx would be retained, with two forest-specific changes, which are identical to alternative B. The effects of the additional exception under VEG S6 for protection of mature whitebark pine trees are the same as described for alternative B. However, there is a difference in effects on lynx and lynx habitat related to winter recreation.

Because of the greater emphasis on wilderness under alternative C, fewer areas would be suitable for over-snow vehicle use as compared to the other alternatives (see figure 1-46, mapped lynx habitat and over-snow vehicle use). As in alternatives B and D, the same large area in the Upper Big, Lower Big and Canyon lynx analysis units would be added as suitable for motorized over-snow vehicle use (about 13,395 acres). About 385 acres of small linear polygons adjacent to existing suitable areas were added in the Bear Creek, Challenge, and Slippery Bill lynx analysis units. Many additional areas, both large and small, that are within recommended wilderness would be designated as unsuitable for motorized over-snow vehicle use, a change from the current condition. This change would occur in 10 lynx analysis units within the North Fork Flathead River geographic area, 7 lynx analysis units in the Middle Fork geographic area, 13 lynx analysis units within the Hungry Horse geographic area, 3 lynx analysis units in the South Fork geographic area, 13 lynx analysis units in the Swan Valley geographic area, and 1 in the Salish Mountains geographic area for a total of about 177,000 acres. This represents almost 10 percent of the Forest’s 1.8 million acres of lynx habitat, which would change from suitable to unsuitable for motorized over-snow vehicle use. In addition, under alternative C, late-season motorized over-snow vehicle use play areas (which also include lynx habitat) would be incorporated into recommended wilderness areas where this use would no longer be suitable.

The effects of the added areas suitable for over-snow motorized vehicle use are very similar to alternative B. It is uncertain whether decreasing the total acreage that is suitable for motorized over-snow vehicle use across many areas of the Forest would result in more concentrated use, and potentially more routes and play areas with consistent snow compaction, in the remaining areas that are suitable for this use; or whether the reduced opportunity would result in an overall reduction in this form of recreation. On balance, it is likely that this alternative would have a small potential benefit to lynx as compared to the other alternatives, by reducing snow compaction and disturbance of lynx in recommended wilderness areas.

Summary and conclusion for alternative C

Under alternative C, the Northern Rockies Lynx Management Direction would remain in place with the same Forest-specific changes as alternative B. The effects to lynx of potential vegetation treatments to protect whitebark pine and the additional areas suitable for motorized over-snow vehicle use are similar to those described for alternative B, except that there would be a much larger reduction in the acres that are suitable for over-snow vehicle use, since recommended wilderness would be changed to unsuitable. Areas where over-snow motorized vehicle use would become unsuitable are expected to have a small benefit to lynx by reducing snow compaction and disturbance. Overall, the direction would maintain or improve lynx habitat in the long term, although some minor short-term adverse effects would occur as a result of the new exception to VEG S6, similar to alternative B.

Alternative D

This alternative emphasizes more active vegetation management, including timber harvest, to achieve desired conditions. There is more emphasis on semi-primitive motorized and roaded recreation opportunities. There are more acres suitable for timber production in this alternative, particularly acres of MA 6c, with an expected higher level of management intensity. No recommended wilderness is included in alternative D. Additional MA 7 (focused recreation areas) is designated including an area featuring off-highway motorized recreational opportunities and increased areas of non-motorized emphasis.

Under this alternative, the existing objectives, standards and guidelines for lynx would be retained in the Flathead Forest Plan, with two forest-specific changes, which are identical to alternative B. The effects of the additional exception under VEG S6 for protection of mature whitebark pine trees are the same as described for alternative B. However, there is a difference in effects on lynx and lynx habitat because there would be an increase, offset by very little reduction, in acres suitable for over-snow vehicle use under this alternative.

Under alternative D, the wording of HU G11 would be modified to allow a net increase in the area suitable for over-snow motorized vehicle use of 1 percent (see figure 1-47, mapped lynx habitat and over-snow vehicle use). As with alternatives B and C, the same large area in the Lower Big and Canyon lynx analysis areas would be added as suitable for motorized over-snow vehicle use (about 13,850 acres). Additional areas in the Canyon and Lakalaho lynx analysis units, totaling about 2495 acres, would also become suitable for motorized over-snow vehicle use, to respond to all of the requests by the Whitefish Range Partnership collaborative group. Two small areas totaling about 1,900 acres in the Bear Creek and Challenge-Granite lynx analysis units also would become suitable. Two small areas in the Glacier and the Slippery Bill lynx analysis units would become unsuitable for over-snow vehicle use. These changes would result in a net increase in the area suitable for over-snow vehicle use of about 19,594 acres on the Forest. Overall, under alternative D, an additional 1 percent of the Forest's 1.8 million acres of lynx habitat would be suitable for over-snow vehicle use as compared to the no action alternative. This would likely result in slightly more adverse impact on lynx than alternative B.

Summary and conclusion for alternative D

Under alternative D, the existing objectives, standards and guidelines for lynx would remain in place with the same Forest-specific changes as alternative B. The effects of vegetation treatments on lynx are the same as those described for alternative B. There would be about a 1% net increase in the acres that are suitable for over-snow vehicle use, because currently suitable areas in the Kah Soldier, Stony Jungle and Sullivan lynx analysis units would remain suitable. Areas added in the Canyon and Lakalaho lynx analysis units would be likely to receive fairly consistent snow compaction due to their proximity to the Whitefish Mountain Resort and/or groomed routes. This would have somewhat greater negative effects on lynx and snowshoe hares than the other alternatives. Overall, the direction would maintain or improve lynx habitat in the long term, although more adverse effects would occur than under the other alternatives.

Cumulative effects

The area in northwest Montana that Squires et al. (2013) delineated as the occupied range of lynx in the Northern Rockies is used for the cumulative effects analysis area. This area spans about 13,900 mi^2 and generally encompasses all forested areas with recent evidence of lynx presence, including telemetry locations from 1998-2007. The cumulative effects analysis area is predominantly National Forest System lands, and also includes Glacier National Park, state managed lands, tribal lands and private lands.

Two national forests make up the bulk of the lands in this area, the Flathead and the Kootenai National Forest (which is adjacent to the Flathead to the west). There are 47 LAUs on the Kootenai NF, encompassing about 1,151,000 acres of lynx habitat (i.e., boreal forest habitat types). To the south, the Seeley Lake District on the Lolo National Forest and the Lincoln District on the Helena National Forest also provide lesser amounts of lynx habitat in the cumulative effects analysis area. Lynx habitat on these national forests is managed through implementation of a consistent set of forest plan objectives, standards and guidelines (see appendix F, Northern Rockies Lynx Management Direction). Habitat management on these units in concert with the Flathead National Forest promotes the conservation of lynx.

Management of Glacier National Park and the forest management plan for the Flathead Indian Reservation incorporate the conservation measures of the Lynx Conservation Assessment and Strategy. This serves to minimize adverse effects to lynx and to promote consistency in habitat management approaches. The Montana Department of Natural Resources and Conservation (DNRC) manages the Stillwater State Forest, the Coal Creek State Forest, and the Swan State Forest, as well as sections acquired from Plum Creek Timber Company in the Swan Valley. DNRC manages lynx habitat according to their habitat conservation plan (HCP). Private lands represent a small fraction of lynx habitat, and the final rule listing the lynx as a threatened species did not find that present conditions on private lands threaten the lynx. There is a potential for future management to have negative effects on lynx, although

USFWS (2007) concluded that some of the negative effects would be moderated by federal land management within the large landscapes inhabited by an individual lynx.

As described previously, the 2013 Lynx Conservation Assessment and Strategy identified four anthropogenic influences (the upper tier) as being of greatest concern to the conservation of the lynx: climate change, vegetation management, wildland fire management, and fragmentation of habitat. These therefore are considered in some detail in this section to evaluate the potential for cumulative adverse effects. The “lower tier” of anthropogenic influences include recreation, minerals and energy management, forest/backcountry roads and trails, grazing by domestic livestock and mortality due to incidental trapping or illegal shooting. While the lower tier activities could affect individual lynx, they are not expected to have a substantial effect on the overall lynx population, and unlikely to cause cumulative adverse effects. Therefore they are not discussed in detail.

Future climate change

The preliminary Northern Region Adaptation Partnership risk assessment for the Canada lynx (NRAP 2015) states that lynx have little or no adaptive capacity to live in areas lacking snow and have limited ability to shift their diet away from snowshoe hares. The authors estimate the likelihood of future climate change effects is high, with a moderate magnitude of effects by 2030 and a high magnitude of effects by 2050. There is a potential for climate change to reduce the extent of deep snow habitats preferred by lynx. McKelvey et al. (2011) estimated that contiguous areas of spring snow cover would become smaller and more isolated throughout the Columbia River Basin, with greatest losses at the southern periphery, but possible increases in snow at higher elevations in the core. Regardless of snow depth, the timing of snowmelt is already occurring about two weeks earlier in recent decades. Mills and Johnson (2013) used an ensemble of locally downscaled climate projections and forecasted that annual average duration of snowpack will decrease by 29–35 days by midcentury. Unless snowshoe hares show enough plasticity to adapt to earlier snowmelt, the reduced snow duration will increase the number of days that white hares will be mismatched on a snowless background. This lack of camouflage coloration may make lynx more successful in detecting their primary prey, but in the long-term it may also reduce snowshoe hare numbers, especially at relatively lower elevations where snow reductions in the northern Rockies are anticipated to be greatest.

Large wildfires in lynx habitat are also believed to be strongly associated with changing climate factors. Westerling et al. (2006) compiled information on large wildfires in the western United States from 1970–2004; and found that large wildfire activity increased suddenly and markedly in the mid-1980s, with higher large-wildfire frequency, longer wildfire durations, and longer wildfire seasons. The greatest increases occurred in mesic, middle and high elevation forest types in the northern Rocky Mountains. Westerling stated that fire exclusion has had little impact on natural fire regimes of these higher-elevation forest types in this area; rather, climate appears to be the primary driver of forest wildfire risk.

Vegetation change through time was modeled for vegetation types and for lynx habitat using the SIMPPLLE model (see DEIS appendix 3). On the Forest over the next 50 years, the model predicts that subalpine fir presence will be maintained. However, a steep decline of nearly 20% in both spruce and lodgepole pine presence occurs in the cool-moist biophysical setting (figures B-11 to 16), likely due mainly to the effect of bark beetles. The model estimates that the subalpine fir and spruce dominance types are either maintained or increased somewhat over time, depending on the alternative. A large portion of the forest (about 65% of the area in the cool moist-mod dry biophysical setting) is currently in a moderate to high density class (as measured by FIA canopy cover). Over the first three decades the model estimates that this proportion remains steady, but then declines while the proportion of low density forest increases. Lower forest densities are probably largely driven by natural disturbances (fire, insect, disease) which converts large areas to early successional forest in the latter modelled decades, with temporarily less canopy cover. This is a natural fluctuation over time associated with the characteristic fire regimes and disturbance processes within this biophysical setting. The increasing proportion of low canopy cover forest may reduce the quality and connectivity of lynx habitat, except where accompanied by an increase in development of vegetation in the understory and mid-story.

These changes in vegetation were also modelled by Ecosystem Research Group as they relate to potential snowshoe hare and Canada lynx habitat.(see appendix 3). The natural range of variation (NRV) was modelled going back about 1000 years and effects of alternatives were projected for the next 50 years, including the fire suppression logic of the model and anticipated changes in climate. ERG modeling estimated the maximum and minimum amountsof the stand initiation phase on the Forest that would have occurred historically due to naturally-occurring fires. The model predicts all alternatives would stay within the minimum and maximum range of NRV over the 5 decade time period. There is a wide range of variation of about 180,000 acres between maximum and minimum NRV. Modelling indicates the stand initiation phase would have been a maximum of about 13% of all lynx habitat at a forestwide scale. This is because the stand initiation phase occurs for a relatively short period of time following major disturbances (e.g. stand-replacing fire) which typically begins once small trees and shrubs have regenerated (about 20 years after the disturbance on average on the Forest) but may only last another decade or two until the stand moves into stem exclusion condition (depending upon factors such as elevation and stem density). On the Forest, where conifer growth is rapid in the moist habitats providing lynx habitat and natural disturbance intervals are fairly infrequent, the acres of stand initiation phase will fluctuate up and down. The forest plan alternatives being considered would allow varying levels of regeneration timber harvest, but it is clear that none would attain the amount of naturally-occurring fires (NRV) that would have occurred historically, or that are likely to occur due to future changes in climate.

Over the past several decades, fire suppression has led to excessive fuels accumulation, particularly in lower montane forests that occur below higher-elevation lynx habitat. Under a warmer, drier climate scenario, these forests are also more susceptible to uncharacteristically severe wildfires, which may then spread into lynx habitat at higher elevations. Fuels reduction on public and private lands at the lower elevations could be helpful in preventing a rapid increase in the frequency and extent of stand-replacing wildfires in the lynx core area. Fuels reduction programs have ramped up in recent years and are expected to continue on most federal, state, tribal and private lands within the boundaries of Forest geographic areas.

ERG also modeled multistory forest that provides snowshoe hare and lynx habitat. The model is not able to discern whether a dense understory is present or not, so this should be interpreted as areas with a potential to provide winter snowshoe hare and lynx habitat. What the model depicts is the trend in forest stands that are most likely to have a multi-storied structure, high canopy closure, and presence of subalpine fir and spruce. The range between maximum and minimum NRV is very large, almost 650,000 acres.

Since the model reduces harvest based upon lynx standard VEG S6 and applies fire suppression logic as well as forest succession for all alternatives, levels of modelled habitat slightly exceeds the maximum range of NRV for the first two decades. By the third decade, modeled levels of fire, insects and disease increase, consistent with projected changes in climate by mid-century. Despite plan components to maintain or increase multi-storied hare and lynx habitat, modeled declines below current levels are projected to occur by the end of five decades, regardless of alternative. This suggests that the current level of modeled multi-storied habitat may be unsustainable based on inevitable and unavoidable natural disturbances, which are projected to increase with a warmer, drier summer climate. These disturbances would return levels to within the modeled maximum NRV.

If insects/disease kill scattered patches of trees in the overstory of multi-storied forests, it could increase the density of the understory, creating multi-storied stands after a lag time of a few decades, provided the loss of canopy cover is not too great. In contrast, stand replacing wildfires would create more stand initiation habitat after a lag time of a few decades. According to modelling of NRV, fire cycles affecting the amount of multi-storied and stand initiation habitat have probably occurred in the past and are likely to occur in the future in the mid to high elevation subalpine-fir and spruce forests of the Forest. Much still needs to be learned with respect to lynx response to wildfire over long periods of time, but lynx are have persisted in the Northern Rocky Mountains with these fluctuations in historic levels of fire, insects, and disease.

Vegetation management and wildland fire management:

In the past, timber harvest removed all size classes of trees, snags, and down logs in mixed species forests containing spruce-subalpine fir, resulting in loss of multistory stands as well as fragmentation of cover. On cool-moist habitat types, forests regenerated in the 1950's and 1960's, including those that had precommercial thinning following harvest, are now developing into forests with a multistory canopy structure, in some cases containing a dense understory. During the same time period, an extensive insect and disease outbreak killed large-diameter spruce. Removal of scattered mature spruce trees allowed a dense understory of subalpine fir and shrubs to grow in many of these areas.

On national forests during the last decade, timber harvest practices have been more favorable for lynx as a result of forest plan amendments, with fewer acres impacted by temporary loss of multistory stands that provide snowshoe hare and lynx habitat. Outside the wildland urban interface, precommercial thinning practices have also been more favorable for lynx, with fewer acres experiencing short-term reductions in snowshoe hare habitat.

- On the Kootenai NF, the maximum acres of lynx habitat that could be affected by exemptions for fuels management in the wildland-urban interface is no more than 57,052 acres. Exceptions for precommercial thinning projects for resource benefits could affect another approximately 11,862 acres. Thus far, the level of effects related to vegetation management on the national forests is substantially lower than what was anticipated in the 2007 Record of Decision for the Northern Rockies Lynx Management Direction and the USFWS' biological opinion. From 2007-2012, approximately 7,271 acres were burned by wildfires in lynx habitat within lynx analysis units on the Kootenai NF (J.Anderson pers. comm. 08/09/2013).
- On the Helena NF, the maximum acres of lynx habitat that could be affected by the wildland-urban interface exemption is 26,400 acres. Exceptions for precommercial thinning projects for resource benefits are limited to 730 acres. Combined, the exemptions and exceptions could affect about 6% of the lynx habitat on the Forest. To date, the level of effects to lynx are substantially lower than what was anticipated in the Record of Decision for the Northern Rockies Lynx Management Direction, as the actual amount of treatments on the Helena NF total only about 200 acres under the wildland-urban interface exemption (D.Pengeroth, pers. comm. 03/29/2016).
- On the Lolo NF as a whole, the maximum acres of lynx habitat that could be affected by exemptions for fuels management in the wildland urban interface is no more than 16,900 acres. Exceptions for precommercial thinning projects for resource benefits could affect another approximately 2,200 acres of lynx habitat. To date, the level of effects to lynx are substantially lower than what was anticipated in the Record of Decision for the Northern Rockies Lynx Management Direction, as the actual amount of treatments on the Lolo NF total only about 300 acres under the wildland urban interface exemption (E.Roberts, pers. comm. 4/26/2016).

Glacier National Park and the Confederated Salish and Kootenai Tribe incorporated the Lynx Conservation Assessment and Strategy into their management plans. Glacier National Park does not conduct commercial timber sales, but does use fire as a vegetation management tool. Vegetation management in lynx habitat on the CSK reservation is similar to the national forests.

The Department of Natural Resources and Conservation (DNRC) manages the Stillwater State Forest in the Salish Mountains geographic area, the Coal Creek State Forest in the North Fork Flathead River geographic area, and the Swan State Forest, as well as sections acquired from Plum Creek Timber Company, in the Swan Valley geographic area. DNRC manages lynx according to their habitat conservation plan (HCP). In their Record of Decision on Proposed issuance of a permit to Montana Department of Natural Resources Conservation, authorizing incidental take of endangered and threatened species on forested trust lands in western Montana, the USFWS concluded that removal of winter foraging habitat from scattered parcels in occupied habitat will not result in adverse effects on lynx for the following reasons: 1) scattered parcels in occupied lynx habitat support about 13% (11,600 acres) of the total winter foraging habitat in the HCP project area, 2) the anticipated 230 acres of annual harvest of winter foraging habitat would be spread across more than 11,600 acres of winter foraging habitat on scattered parcels in occupied habitat, 3) the amount of occupied habitat treated would likely represent a small proportion of a lynx home range and would not be enough to measurably reduce snowshoe hare productivity in the home range, and 4) viable lynx habitat would be retained through implementation of the HCP commitments combined with the availability of habitat on adjacent LAUs where standards on Federal lands regulate treatments of winter foraging habitat in multi-storied stands (USFWS 2011). Where practicable, DNRC will consider harvest unit designs at the project level to maintain a connected network of suitable lynx habitat along riparian areas, ridge tops, and saddles that connect third-order drainages. Measures for grizzly bears that will limit the size of forest openings that can be created through timber harvesting, as well as measures for secure cover, will also provide habitat connectivity for Canada lynx.

Most private lands within the Forest geographic areas are at elevations too low to be lynx habitat, but lynx do cross through these areas. There are some private parcels in the Middle Fork and North Fork of the Flathead River, as well as in the Swan Valley and Stillwater Valley near Olney that are at elevations suitable for lynx. Some of these landowners are clearing vegetation to reduce the risk of wildfire, which may reduce the potential for lynx foraging, although whether lynx would forage in close proximity to human dwellings, dogs, etc. is unknown. Fuels treatments in lower montane forests help to prevent uncharacteristically severe fires from occurring, which are difficult to control and have the potential to spread up into lynx habitat.

Fragmentation of habitat due to highways or activities on other ownerships

Highways. Although lynx are known to cross openings, Squires and others found that lynx generally use habitat within about 300 feet of cover (Squires et al. 2013). Most of northwest Montana is heavily forested, with the largest non-cover areas occurring in agricultural valleys (such as the Flathead Valley) and in areas recently burned by stand-replacing wildfire. Alternatives B, C, and D have a guideline stating that when conducting vegetation management projects, cover of trees and/or tall shrubs should be retained (if available) between areas of forest where cover is lacking (e.g. recent stand-replacement fire areas, clearcut, seedtree, or shelterwood harvest units), so that connectivity between forested patches is not severed. This guideline is intended to benefit multiple wildlife species and would benefit lynx. Because cover is altered by wildfire, insects and pathogens, and actions on private lands, it is difficult to predict when or where this action would occur.

There are no four-lane highways in the cumulative effects analysis area and lynx are known to cross the existing two-lane highways. Given that increased traffic and urbanization are projected for the Northern

Rockies (Hansen et al. 2002), mitigation measures such as land purchases and conservation easements may be necessary to preserve connectivity among lynx populations. If traffic volume greatly increases, the construction of wildlife crossing structures could be considered (Squires et al. 2013, Clevenger and Waltho, 2005). To address these potential changes on private lands, alternatives B, C, and D have a forestwide desired condition stating that land ownership adjustments, through purchase, donation, exchange, or other authority, will be considered to improve national forest management by consolidating ownership, reducing wildlife-human conflicts, providing for wildlife habitat connectivity, improving public access to public lands, and retaining or acquiring key lands for wildlife and fish and within Wild and Scenic River corridors. Because these actions require a willing landowner, it is difficult to predict when or where they may actually occur.

Canada. Connectivity to source populations of lynx in Canada is considered critical to persistence of populations in most parts of the range in the United States (Federal Register Vol. 68 pp. 40076–40101, Squires et al. 2013). Connectivity from the Forest to Canada is currently high, with cover conditions that facilitate lynx travel and only two-lane gravel roads within the cumulative effects area.

Mortality due to incidental trapping or illegal shooting of Canada lynx

Trapping and snaring of lynx is currently prohibited across the contiguous United States. Incidental trapping or snaring of lynx is possible in areas where regulated trapping for other species, such as wolverine, coyote, fox, fisher, marten, bobcat and wolf, overlaps with lynx habitats (Squires and Laurion 2000). A trapped lynx can be released, but there is potential for accidental injury or mortality. Kolbe et al. (2003) compared the use of a box trap, padded and unpadded foothold traps and foot snares to capture lynx, to assess trap efficacy and risk of injury. The combined injury rate in the foothold traps was 43 percent (14 of 39 captures in padded foothold traps, and 8 of 12 captures in unpadded traps) which caused major or minor injuries.

State wildlife management agencies regulate the trapping of furbearers. Trapper outreach is used as a tool to avoid or minimize incidental take of lynx. MFWP has implemented special regulations to reduce the likelihood of incidental capture of lynx. A recent court settlement with MFWP established a lynx protection zone, which includes the Flathead National Forest, that restricts the size and the placement of traps and snares that can inadvertently catch lynx and requires bobcat trappers to check their traps at least once every 48 hours. The use of fresh meat or feathers as bait is now prohibited in the lynx protection zone. MFWP also provides education and outreach programs aimed at preventing illegal shooting of lynx.

The magnitude of illegal shooting of lynx is unknown. Incidents have been reported throughout the range of the species. Devineau et al. (2010) reported a substantial number of shootings of lynx during the first 10 years after reintroduction into Colorado (14 known shootings and 5 probably out of 102 known mortalities). State wildlife agencies work to reduce lynx mortality by disseminating information to the public and providing guides to identifying characteristics to hunters

Over-snow vehicle use could facilitate access to lynx habitat and increase the vulnerability of lynx to incidental trapping or illegal shooting. Glacier National Park is closed to trapping and to over-snow vehicle use, greatly reducing the risk of mortality. Incidental trapping-related mortality of collared animals has been documented to occur in the Seeley-Swan study area (J.Squires, pers. comm. 3/24/2016, planning record exhibit V-37). One lynx was reported trapped on the Kootenai NF in December 2012 and was released unharmed (J. Zelenak 8/26/2013 pers. comm. to Jeremy Anderson).

At southern latitudes, where lynx population density and productivity are lower than in the northern part of its range, harvest may be an additive source of mortality and lynx may be highly vulnerable to overexploitation (Koehler 1990). Aubry et al. (1999) hypothesized that human-caused mortality such as illegal or incidental harvest could significantly reduce lynx population numbers in southern regions. The state wildlife agencies have taken actions to reduce incidental or illegal trapping and shooting, which reduces the potential for adverse cumulative impacts.

Recreational activities

Scientific evidence to date indicates that most recreational activities pose a low risk of having negative effects on lynx (Interagency Lynx Biology Team 2013).Within the cumulative effects analysis area outside of the Forest, there is one ski area on the Kootenai National Forest (Turner Mountain). This is a very small ski area with only one lift, and very little development at the base. The ski area affects about 263 acres of lynx habitat, with 164 acres of cleared ski runs and 98 acres of gladed skiing. Summer activities such as hiking are also provided. Snowbowl ski area is located on the Lolo NF and affects about 1,190 acres of lynx habitat in the Rattlesnake lynx analysis unit. Over 90% of this lynx analysis unit is within the Rattlesnake National Recreation Area and Wilderness. While the Turner Mountain and Snowbowl ski areas may have some local adverse effects, they would not be expected to contribute to cumulative adverse effects on the lynx population.

There is a potential for snowmobile use to increase in the cumulative effects analysis area, which could increase mortality risk to lynx. However, many areas of lynx habitat have limited accessibility for off-route snowmobiling due to high tree densities and rugged topography. On the Kootenai NF, there are approximately 120 miles of groomed over-snow motorized routes and approximately another 46 miles of designated routes in lynx habitat within lynx analysis units. Additionally, there are approximately 5 miles of groomed cross-country ski trails in lynx habitat within lynx analysis units, and another 5 miles that are designated for cross-country ski use. These mileages are less than what was analyzed in the Northern Rockies Lynx Management Direction Final EIS, due to better mapping and some routes being dropped due to lack of snow (M. Laws, personal communication 9/17/12 as cited in USFS 2013a, p.29). There are no designated play areas on the Kootenai NF, although it is likely that some areas receive concentrated use.

Minerals and energy exploration and development

On the Kootenai NF, no leasable minerals (e.g. oil, gas, coal, geothermal resources, etc.) are being produced. Same as the Flathead National Forest, all leases are currently suspended in accordance with the 1985 court decision Conner vs. Burford (848 F.2d 1441 (9th Cir. 1988).

A copper/silver mine has been in operation for over 20 years on the Kootenai NF, and affects approximately 50 acres on National Forest System lands and an additional 400 acres of private lands (USFS 2003). In 2006 the USFWS issued a biological opinion for the re-start of the Troy Silver mine (USFWS 2006), which concluded that the mine would not have adverse effects on lynx. However, the Troy Mine has now been shut down and is moving into the reclamation phase. Various analyses have also been completed for the Rock Creek Mine, which also determined the mine is not likely to adversely affect lynx or lynx habitat. There are no Plans of Operation or Notices of Intent to explore or operate any commercial mines in lynx habitat on the Lolo National Forest, The Cotter Basin Mine on the Helena NF had produced copper and silver in the past.

In its biological opinion on the Northern Rockies Lynx Management Direction, USFWS (2007) concluded that the application of the amendment guidelines would result in no or only minor adverse effects to lynx due to minerals and energy development. No adverse cumulative effects are anticipated.

Forest roads

Much of the lynx habitat on the Kootenai, Lolo and Helena NFs overlaps with grizzly bear habitat, where road construction and motorized use is constrained. The objectives and guidelines contained in the forest plans for lynx reduce or minimize any potential adverse effects (USFWS 2007) and no adverse cumulative effects are anticipated.

Livestock grazing

The effects of livestock grazing were anticipated to be minimal under the Northern Rockies Lynx Management Direction (USFWS 2007) and no new infromatin suggests that this has changed. No adverse cumulative effects are anticipated.

Summary and conclusion regarding cumulative effects on lynx:

In its 2007 biological opinion, USFWS concluded that the objectives, standards and guidelines in the amended Forest Plans provide comprehensive conservation direction adequate to reduce adverse effects to lynx from forest management on National Forest System lands and would not result in jeopardy to the lynx Distinct Population Segment. Continuing to implement this set of direction is expected to contribte to the conservation of the lynx. No cumulative adverse effects to lynx are anticipated to occur as a result of management actions on other national forests within the cumulative effects analysis area. Glacier National Park and the Confederated Salish and Kootenai Tribe incorporated the Lynx Conservation Assessment and Strategy into their management plans and DNRC manages in accordance with their HCP, which help to minimize adverse effects on those lands. Only a small fraction of lynx habitat occurs on private lands, and there is little potential for adverse cumulative impacts. Mortality due to incidental trapping or illegal shooting have the potential to cause cumulative adverse effects, but the magnitude of this mortality is unknown and MFWP has implemented several programs and regulations aimed at reducing this risk. Climate change has the most potential for adverse cumulative effects, due to larger and more frequent disturbances than were typical in the past, and the potential reduction in the amount and persistence of deep snow. At this time, the magnitude of effects of future climate change is unknown.

Canada lynx critical habitat

Affected Environment - Canada Lynx Critical Habitat on the Flathead National Forest

Critical habitat was designated for Canada lynx in 2009 (Federal Register vol.74, no. 36, Wednesday, February 25, 2009) and revised in 2014 (Federal Register Vol. 79, No. 177, Friday, September 12, 2014). USFWS designated five units of critical habitat, in the States of Idaho, Maine, Minnesota, Montana, Washington, and Wyoming. For the lynx, only areas that were within the range of the species at the time of listing were designated as critical habitat.

As part of the critical habitat listing decision, USFWS identified the physical and biological features that are essential to the conservation of the species and that may require special management considerations or protections. The USFWS determined that the primary constituent element for lynx critical habitat is:

1. Boreal forest landscapes supporting a mosaic of differing successional forest stages and containing:

- Presence of snowshoe hares and their preferred habitat conditions, which include dense understories of young trees, shrubs or overhanging boughs that protrude above the snow, and mature multistoried stands with conifer boughs touching the snow surface;
- Winter snow conditions that are generally deep and fluffy for extended periods of time;
- Sites for denning that have abundant coarse woody debris, such as downed trees and root wads; and
- Matrix habitat (e.g., hardwood forest, dry forest, non-forest, or other habitat types that do not support snowshoe hares) that occurs between patches of boreal forest in close juxtaposition (at the scale of a

lynx home range) such that lynx are likely to travel through such habitat while accessing patches of boreal forest within a home range.

Critical habitat unit 3 is located in the Northern Rockies (figure 39). Lynx are known to be widely distributed throughout critical habitat unit 3 and breeding has been documented in multiple locations. According to the USFWS, this area appears to support the highest density lynx populations in the Northern Rockies. It likely acts as a source population and provides connectivity to other portions of the lynx's range in the Rocky Mountains. This area contains the physical and biological features essential to the conservation of the lynx (the primary constituent elements and its components) laid out in the appropriate quantity and spatial arrangement.

Critical habitat occurs on about 3,425 mi^2 of Flathead NFS lands, which is about 35% of critical habitat unit 3 (see figure 1-49). About 37% of the critical habitat on the Flathead National Forest is in wilderness and special areas. There are only two lynx analysis units on the Flathead National Forest that do not include some critical habitat: the Haskill Mount and Blacktail lynx analysis units west of Flathead Lake and Highway 93.

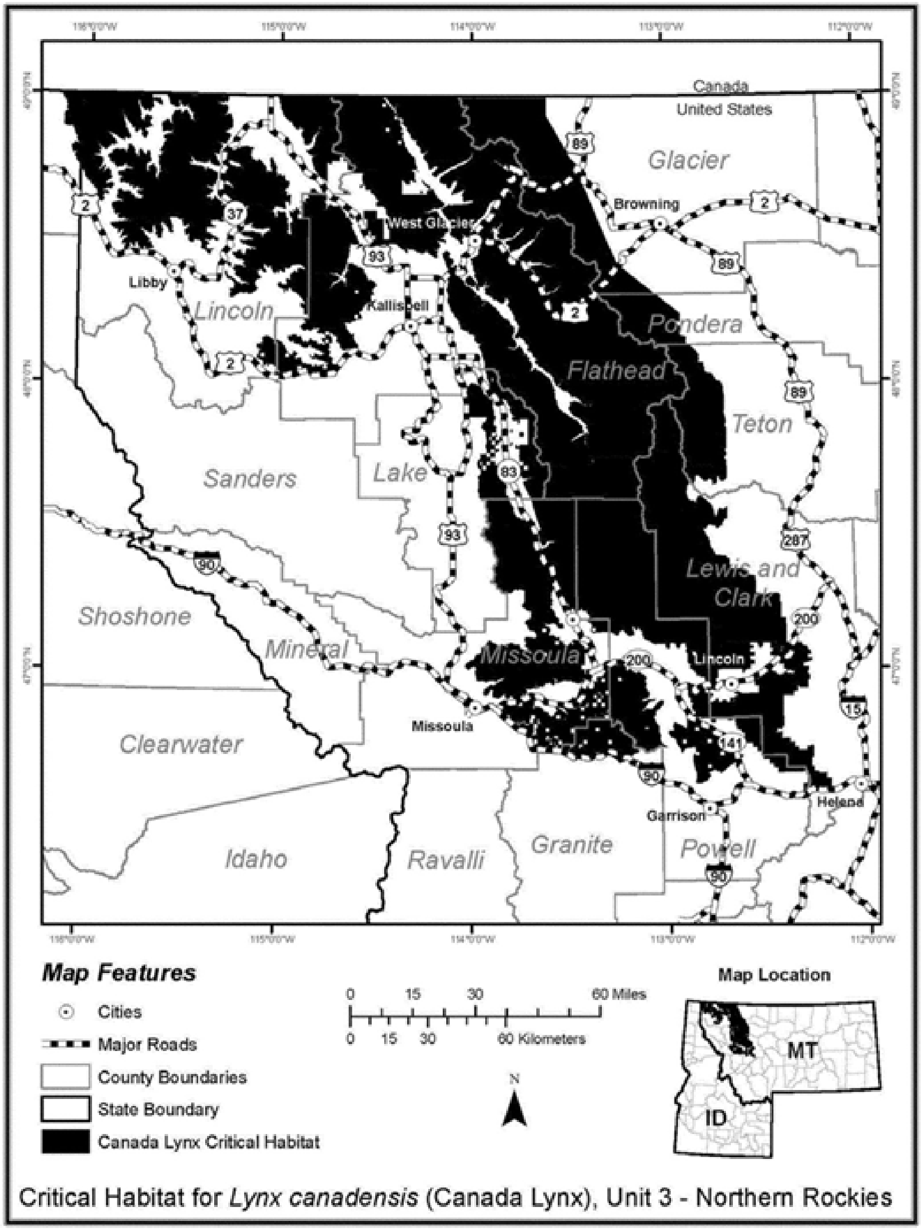


Figure 39. Critical Habitat Unit 3, as shown in the final rule (Federal Register Federal Register Vol. 79, No. 177, Friday, September 12, 2014)

Conservatively, areas where regeneration timber harvest occurred since 1990 may not yet have developed dense understories of young trees, shrubs or overhanging boughs that protrude above the snow (PCE 1a). About 2% of lynx critical habitat on the Forest has had regeneration timber harvest since 1990. In addition, areas that have been burned by wildfire since 1990 may not yet have developed dense understories of young trees, shrubs or overhanging boughs that protrude above the snow. About 24% of critical lynx habitat on the Forest has been burned by wildfires since 1990.

The Northern Rockies Lynx Management Direction was completed in 2007, prior to the final designation of critical habitat, and therefore did not include an analysis of the effects on critical habitat. Nevertheless, the amendment adopted forest plan components that contribute to maintaining the primary constituent elements of lynx critical habitat and avoid actions that potentially could adversely modify critical habitat. Table 59 below lists the Northern Rockies Lynx Management Direction components in relation to the primary constituent elements.

Table 58. Canada lynx critical habitat primary constituent element in relation to Northern Rockies Lynx Management Direction (NRLMD).

Primary Constituent Element	Primary Constituent Element Description	Associated NRLMD Objective, Standard and/or Guideline
1.	*Boreal forest landscapes supporting a mosaic of differing successional forest stages and containing:*	VEG O1, VEG O2, VEG O3, VEG O4
a	Presence of snowshoe hares and their preferred habitat conditions, including dense understories of young trees, shrubs or overhanging boughs that protrude above the snow, and mature multistoried stands with conifer boughs touching the snow surface	VEG O1, VEG O2, VEG O3, VEG O4; VEG S1, VEG S2, VEG S5 and VEG S6; VEG G1, VEG G4, VEG G5 and VEG G10; GRAZ G1, GRAZ G2, GRAZ G3, and GRAZ G4; HU G1, HU G2, HU G8
b	Winter snow conditions that are generally deep and fluffy for extended periods of time;	VEG G4; HU G4, HU G11, and HU G12
c	Sites for denning that have abundant coarse woody debris (downed trees and root wads);	VEG O1; VEG G11; HU G1
d	Matrix habitat (e.g., hardwood forest, dry forest, non-forest or habitat types that do not support snowshoe hares) that occurs between patches of boreal forest in close juxtaposition (at the scale of a lynx home range) such that lynx are likely to travel through such habitat while accessing patches of boreal forest within a home range.	ALL S1; GRAZ G4; HU G3 and HU G7; LINK S1 and LINK G2

Environmental consequences

In its final rule designating lynx critical habitat, USFWS identified the following federal actions that potentially could adversely modify critical habitat. Briefly, these are:

1. Actions that would reduce or remove understory vegetation within boreal forest stands on a scale proportionate to the large landscape used by lynx. These activities could significantly reduce the quality of snowshoe hare habitat such that the landscape’s ability to produce adequate densities of snowshoe hares to support persistent lynx populations is at least temporarily diminished.

2. Actions that would cause permanent loss or conversion of the boreal forest on a scale proportionate to the large landscape used by lynx. Such activities could eliminate and fragment lynx and snowshoe hare habitat.

3. Actions that would increase traffic volume and speed on roads that divide lynx critical habitat. These activities could reduce connectivity within the boreal landscape for lynx, and could result in increased mortality of lynx.

In matrix habitat, activities that change vegetation structure or condition would not be considered an adverse effect to lynx critical habitat unless those activities would create a barrier or impede lynx movement between patches of foraging habitat and between foraging and denning habitat within a potential home range, or if they adversely affect adjacent foraging or denning habitat.

Effects common to all alternatives

Permanent loss or conversion of boreal forest. There are no actions contemplated under the forest plan that would cause permanent loss or conversion of boreal forest at the large landscape scale discussed in the critical habitat rule. Standard ALL S1 requires that new or expanded permanent developments and vegetation management projects in a lynx analysis unit and/or a linkage area must maintain habitat connectivity.

Traffic volume and speed. None of the alternatives contemplate increasing traffic volume or speed on roads that divide critical habitat. Under Guideline HU G6, methods to avoid or reduce the effects on lynx in lynx habitat should be used when upgrading unpaved roads to maintenance levels 4 or 5, if the result would be increased traffic speeds and volumes, or a foreseeable contribution to increases in human activity or development in lynx habitat.

Highway construction and expansion are not under the authority of the Forest Service, but several forest plan components address highway coordination, particularly in linkage areas. These include Objective LINK O1, which encourages working with landowners to pursue conservation easements, habitat conservation plans, land exchanges, or other solutions in mixed ownership areas to reduce the potential of adverse impacts on lynx and lynx habitat. In linkage areas, potential highway crossings will be identified (LINK S1), and Forest Service lands should be retained in public ownership (LINK G1). These forest plan components are beneficial in maintaining or improving habitat connectivity on National Forest System lands, and would help to reduce or minimize adverse modification of critical habitat.

Alternative A

Understory vegetation. The Northern Rockies Lynx Management Direction addressed the vegetation components of lynx habitat, particularly those that provide snowshoe hare habitat. Standards VEG S1, VEG S2, VEG S5 and VEG S6 are specifically aimed at providing adequate amount and arrangement of foraging habitat for lynx over time. All alternatives would protect existing lynx habitat that provides primary constituent element1a, except for allowed exemptions within the wildland-urban interface and allowed exceptions under VEG S5 and VEG S6. Fewer than 1,000 acres have been treated using the VEG S5 and VEG S6 exceptions, a small fraction of the 1.8 million acres of lynx habitat on the Forest. The exemption for the wildland urban interface constrains fuels treatments to no more than 6 percent of lynx habitat, and fewer acres than the estimate were actually treated during the 2007-2015 period. The same acreage allowed for the VEG S5 and VEG S6 exceptions and the fuels treatment in the wildland-urban interface exemption would be continued under this alternative, which would not be likely to result in adverse modification of critical habitat.

Alternatives B, C and D

Understory vegetation. The action alternatives are very similar to alternative A in protecting existing habitat that provides primary constituent element1a. The existing forest plan components would remain in place, with two forest-specific changes. An additional exception to VEG S6 would allow the felling of trees within 200 feet of disease-resistant whitebark pine trees used for cone, scion, and pollen collection, but this would occur on very few acres of lynx habitat. Additionally, the range of acres that could be treated under the exceptions to VEG S5 and VEG S6 may be increased, if within allowable levels of incidental take to be determined through Endangered Species Act section 7 consultation. This could result in short-term adverse effects to critical habitat that would be greater than under alternative A. Overall, the direction would continue to be aimed at maintaining or improving lynx habitat in the long term, although short-term adverse effects may occur.

Cumulative Effects – Canada Lynx Critical Habitat Unit 3

Critical habitat on other ownerships: In Glacier National Park, wildfires since 1990 have affected about 12% of critical lynx habitat (see DEIS Appendix B). These burned areas will provide PCE 1a once trees and shrubs have grown tall enough and dense enough to support snowshoe hares and lynx. These past fires, some of which will soon be moving into stand initiation phase, are not likely to result in an adverse cumulative impact to critical habitat.

Climate change: As discussed above, downscaled winter climate and precipitation models have a higher level of uncertainty than summer climate models (NRAP 2015). There is a potential for future changes in climate to reduce the extent of deep snow habitats preferred by lynx. McKelvey et al. (2011) estimated that contiguous areas of spring snow cover would become smaller and more isolated throughout the Columbia River Basin, with greatest losses at the southern periphery, but with possible increases in snow at higher elevations in the core. In addition, spring snowmelt is already occurring about two weeks earlier in recent decades. Mills and Johnson (2013) forecasted that annual average duration of snowpack will decrease by 29–35 days by midcentury. This may result in a contraction of the area where lynx have a competitive advantage in deep snow.

Summary and conclusion

None of the alternatives would cause permanent loss or conversion of the boreal forest, nor would they increase traffic volume or speed on roads that divide critical habitat. The action alternatives may allow an increase in the acreage treated under the VEG S5 and VEG S6 exceptions, which may result in short term adverse effects on critical habitat, but would be constrained in several ways. Climate change has the potential to contribute adverse cumulative effects, by affecting the extent and duration of deep snow and an increase in the extent, frequency and severity of disturbance events in critical habitat. At this time, the magnitude of these changes are unknown.

In summary, based on the analysis of alternatives and the cumulative effects of other federal and non-federal activities within the plan analysis area, the implementation of the plan components would provide for ecological conditions that support recovery of the Canada lynx. While the Forest Service cannot control all stressors that affect the Canada lynx, plan components provide for key ecosystem characteristics within the authority of the Forest Service and the ecological capacity of National Forest System lands.

3.7.6 Summary of consequences to wildlife from forest plan components associated with other resource programs or revision topics

Consequences to wildlife from forest plan components associated with other resource programs are discussed throughout the wildlife sections of Chapter 3. The following section provides a summary.

Consequences to wildlife from additional recommended wilderness (MA1b)

There are three potential consequences to wildlife associated with the amount of recommended wilderness (MA1b); 1) types of human disturbance, 2) potential size and acres of wildfire, 3) potential for timber harvest. Differences in alternatives for MA1b are:

- Alternative A: there are five areas recommended for wilderness for a total of about 98,400 acres
- Alternative B: there are nine areas recommended for wilderness totaling about 187,700 acres
- Alternative C: there are 17 areas recommended for wilderness for a total of 507,000 acres
- Alternative D: no recommended for wilderness

Alternatives B and D have similar management requirements and suitability for recommended wilderness areas. Alternative C has the most conservation requirements and suitability for recommended wilderness (see Recreation section of chapter 3 for more details).

Because alternative C has the most MA1b (recommended wilderness), the expectation is that wildfire could be used more frequently to meet desired conditions. There would be limitations on use of either mechanical or prescribed fire treatments in these areas in the future (if Congress designates them as wilderness). Because many wildfires on the Forest in recent decades have been stand replacing and large (e.g. 10,000-50,000 contiguous acres), this could result in large areas that are in an early successional stage providing grass/forb/shrub habitats and there could be more acres with snags and down woody material than with Alternatives A, B or D. This would be beneficial for species associated with these key ecosystem characteristics, but could be detrimental to species that are associated with late successional stages, areas of dense cover, and large patches of mature forest.

Timber harvest can have temporary effects on wildlife species that are sensitive to disturbance and longer-lasting effects on species that are associated with burned forests. If recommended wilderness is already in an inventoried roadless area (IRA), timber harvest (including salvage harvest) is not likely to occur, so whether an area has a MA1b designation or other designations, it has minimal effects on wildlife. Differences in alternatives are primarily associated with the acres in recommended wilderness that are not already in IRAs, as shown below.

- Alternative A: Has about 3,000 acres of recommended wilderness that are not in IRAs
- Alternative B: Has about 14,340 acres of recommended wilderness that are not in IRAs
- Alternative C: Has about 39,458 acres of recommended wilderness that are not in IRAs
- Alternative D: Has 0 acres of recommended wilderness

With alternative C, there would be less risk of disturbance associated with timber harvest (temporary road use, noise) and a low likelihood that trees killed by fire, insects and disease would be salvaged on about 39,455 acres. With alternative A, there are a minimal number of acres affected (about 3000), so wildlife effects would be minimal. Alternative B is in between.

Some wildlife species are sensitive to disturbance from certain kinds of recreation activities. Some species are sensitive to motorized disturbance above certain thresholds or motorized access can have indirect effects by making areas more accessible for hunting or trapping. Alternative C has the least risk of disturbance to these species because motorized or mechanized human uses would not be suitable in MA1b. Alternative B allows for existing mechanized transport (mountain biking) or motorized uses (over-snow or motorized trail use) to continue as long as those uses do not prevent the protection and maintenance of the social and ecological characteristics that provide the basis for wilderness, or until such time wilderness (MA1a) designation is adopted by Congress. Even though alternative D does not have recommended wilderness, there would be about 291,071 acres of MA5a where motorized recreation use would not be suitable in any season, so there would be no effects on wildlife species that are sensitive to motorized disturbance. There would be an additional 117,650 acres MA5c where motorized recreation use would be suitable only in winter.

Wildlife species may avoid areas with high levels of recreation use or they may use these areas during time periods when people are not present (e.g nighttime). Except for the Jewel Basin Hiking Area (which has a high density of hiking trails and is very accessible), most recommended wilderness areas on the Forest do not currently have high levels of recreation use. Motorized use is allowed only on designated routes, except in winter. In heavily timbered landscapes such as the Flathead National Forest, there is no scientific evidence that dispersed mountain bike use, horse use, or hiking has any significant effect on wildlife populations. The Jewel Basin Hiking Area already has prohibitions on stock and pack animals, mechanized transport and motorized uses. These prohibitions would continue regardless of MA1b designation.

Consequences to wildlife from access, infrastructure, and recreation management

Effects of alternatives were analyzed for key habitats of wildlife species that may be sensitive to disturbance in particular areas or during particular time periods; including the grizzly bear, Canada lynx, wolverine, mountain goat, elk and deer. Effects to specific species vary by alternative, but the Forest selected routes and areas to minimize harassment to a wide variety of wildlife species, considering effects of seasons of use as well as type and location of use, as discussed in the sections on individual species.

Because many existing roads, trails, developed and dispersed recreation sites on the forest are located adjacent to wetlands and riparian areas, or in some cases, within the flood prone areas of streams, these sites have been impacted in the past (see soils, waterhseds, aquatic species, and riparian ecosystem section of chapter 3 for more details). Non-motorized and motorized watercraft use can also disturb some wildlife species that nest on lake or stream shorelines. Because major rivers and lakes tend to be readily accessible by roads, trails, and watercraft, species-specific plan components are designed to address this impact (see section on wildlife associated with aquatic, wetland and riparian habitats for more details). Protection of water quality, quantity and riparian habitat near recreationally important water bodies is achieved through the implementation of the watershed condition framework and is specified in forestwide plan components. RMZ standards or guidelines specify that new roads are located outside RMZs, except for crossings. This ensures that new routes would not impact streams, lakes, and wetlands, thus providing benefits for important wildlife habitat.

On NFS lands within the Forest, routes and areas where public motorized use would be suitable are generally in forest cover where dense trees and natural topography help provide visual and acoustic barriers to disturbance. There are large undisturbed blocks of forest land where there are no routes designated for motorized use during the grizzly bear non-denning season. These large areas provide secure core habitat for grizzly bears (figures 1-37 to 1-42), elk security areas (figure 1-31), and also provide habitat security and reduced risk of mortality for a wide variety of other wildlife species. Because most areas with road restrictions to benefit grizzly bears are closed to public motorized vehicle use from

April 1 through November 30, they also reduce disturbance near ungulate calving/fawning areas, nesting areas, and important food sources such as riparian grasses, forbs, shrubs or avalanche chutes. In addition, the Forest has managed routes that affect seasonal wildlife habitat needs, by closing key areas such as elk winter habitats on a seasonal basis. As displayed in table 42 and table 43, large areas of the Forest have open motorized access densities less than 1 mi/mi2. With alternative C, limitations on the density of routes open to public motorized use for grizzly bears extends to motorized trails.

Motorized over-snow vehicle use on the Forest is also limited to designated routes and areas, benefiting wildlife species that may be sensitive to human disturbance during the winter. About 19% of the Forest is open to motorized over-snow use from Dec. 1 to March 31, about 10% is open year-long (snow conditions permitting), and about 2% is open April 1 to Nov 30. Three alternatives are considered for specific areas and routes where motorized over-snow vehicle use would be suitable, as displayed in figures B-03 to 05. Alternative A maintains current routes and areas, alternative B reduces them slightly and also shifts locations of some suitable routes and areas, alternative C reduces them greatly, and eliminates all but one area and route open during the grizzly bear den emergence time period, and alternative D increases them slightly.

Recreational use is projected to increase in the coming decades with all alternatives. All alternatives maintain the current permit areas for the Forest's downhill ski areas as well as plan components for their year-round management. The action alternatives B, C, and D include a variety of mapped acreages of management areas suitable for focused recreation (MA7). Focusing developed recreation in these areas, in conjunction with standards and guidelines for grizzly bears, would help limit the extensiveness of potential impacts to wildlife species that are sensitive to human disturbance. There is little evidence that summer recreation or forest roads and trails would have substantial negative effects on lynx or their habitat (Interagency Lynx Biology Team 2013 p. 80, 84-85). The limits on oil and gas development and on expansion of developed recreation sites under this alternative could contribute to maintaining connectivity within and between areas of lynx habitat.

Consequences to wildlife from vegetation management

Four alternatives were considered, including a variety of mapped locations and acreages of management areas suitable for timber production to contribute to ecological, economic, and social sustainability. Desired conditions for vegetation were integrated with wildlife habitat needs and the biodiversity goals of the 2012 planning rule. Forestwide standards and guidelines promote the retention and development of key ecosystems and ecosystem characteristics including (but not limited to) riparian vegetation, old growth, very large live trees, snags, large down woody material and connectivity within vegetation management project areas. Plan components to provide for a variety of forest successional stages and restore historic tree species composition or historic structure (e.g seed-producing whitebark pine, less dense ponderosa pine forest structure) are also beneficial to wildlife. Desired conditions for wildlife may be met using a variety of active management techniques (e.g. timber harvest, pre-commercial thinning, planting, prescribed fire). Vegetation plan components could help make forests more resilient with respect to likely future environments, where feasible, within USFS authority and capability of lands. Modelled vegetation and wildlife habitat stays within the maximum and minimum levels of the natural range of variation with all alternatives.

Roads associated with timber harvest can have negative effects on wildlife. All action alternatives benefit wildlife because they include: 1) standards for riparian management zones that limit roads in riparian areas, 2) standards for grizzly bears require that roads are maintained at baseline levels (see glossary), and 3) objectives to decommission or place into intermittent stored service 30 to 60 miles of roads in key areas. Alternatives A and C could close additional roads to meet requirements of amendment 19 or to meet desired conditions for recommended wilderness. With all alternatives, invasive plants are treated using an integrated approach, with a site-specific determination of which control methods (mechanical, biological, or chemical) are most effective and best suited for the site. Plan components to control invasive plant species also benefit wildlife species by promoting ecosystem integrity.

Under alternative C, all of the vegetation management guidelines that apply to the grizzly bear primary conservation area under alternative B would also be applicable to the Salish demographic connectivity area. Compared to alternatives A, B, and D, this emphasis results in more acres of MA6a or 6b rather than 6c in the Salish DCA, which could be beneficial to species associated with forest cover to provide connectivity.

Consequences to wildlife from fire management

Fire management using prescribed burning and the use of natural, unplanned ignitions to meet resource objectives has a positive effect on some wildlife species but not others. Plan components for all action alternatives promote use of fire as an important tool in moving vegetation towards desired conditions. The action alternatives have plan components that address the value of areas burned with stand replacing fire for some wildlife species. The action alternatives include plan components to address wildlife needs during salvage harvest in wildfire areas. The alternatives also recognize the need to protect human safety and infrastructure, and to salvage dead trees to contribute to economic and social sustainability in certain locations. In lands within the wildland urban interface, particularly near communities, a continued policy of aggressive fire suppression is expected and will require that mechanical treatment methods be used in order to reduce hazardous fuels and trend the vegetation towards desired conditions. This effect is common to all alternatives and would benefit species associated with mature forest or old growth habitat, but not species associated with intensively burned forest.

Consequences to wildlife from air quality management

The consequences to forest vegetation from air quality related Forest Plan direction are the same for all alternatives. All alternatives have direction to meet air quality standards established by federal and state agencies and meet the requirements of state implementation plans and smoke management plans. The direction benefits air quality for people as well as wildlife, but limits the use of prescribed fire to manage forest vegetation by limiting days when prescribed burning can occur. Since days with conditions that are suitable for prescribed burning are limited, habitat improvement projects (e.g. creating forage for species such as elk or moose) may take many years to accomplish. This effect is common to all alternatives.

Consequences to wildlife from watershed, soil, riparian, and aquatic habitat management

All alternatives contain direction that protects watershed integrity, soil productivity, as well as riparian and aquatic wildlife habitats. Riparian management zones (RMZ's) provide key wildlife habitats. About 20% of the RMZ acres are within management areas (MAs) that are suitable for timber production and the remaining 80% of the Forest's RMZs are in management areas that are not suitable for timber production. With alternatives B, C, and D there are about 427,320 total acres of NFS lands in RMZs, which are not suitable for timber production with any alternative (see section 3.2 for more details). However, timber harvest may occur in the RMZ it is in conformance with RMZ desired conditions, standards, and guidelines. In order to achieve watershed desired conditions, the RMZ is broken into two areas called the inner and outer RMZs. Some activities are prohibited or restricted in the inner RMZ, whereas more active management is allowed in the outer RMZ. Vegetation management can only occur in the inner RMZ when necessary to maintain, restore or enhance aquatic and riparian associated resources and to meet RMZ desired conditions. Vegetation management can only occur in the outer RMZs, so long as project activities in RMZs do not result in long-term degradation to aquatic and riparian conditions. Plan components for RMZ's (alternatives B, C, and D) or RHCA's (alternative A), benefit many aquatic and terrestrial wildlife species. Plan components for restoration of five class 2 watersheds would also benefit wildlife by promoting aquatic, riparian, and wetland integrity.

Additional species-specific plan components support species associated with particular types of aquatic or riparian habitats as well as those that may be sensitive to disturbance in particular areas or during particular time periods; including (but not limited to) harlequin ducks, black swifts, bald eagles, and common loons.

Consequences to wildlife from management of mineral exploration or development

Three alternatives were considered, including standards and guidelines for the grizzly bear that limit consequences from mineral and energy exploration or development. These activities undergoes site-specific NEPA analysis to determine effects and to ensure that required mitigation measures are included in plans of operations and rehabilitation requirements, if needed. Though the potential for development of leasable and locatable minerals on the Forest is low, plan components for the grizzly bear would also benefit many other wildlife species. Because there is a "no-surface-occupancy" stipulation for designated wilderness and because alternative C would apply "no-surface-occupancy" for the grizzly bear primary conservation area, this alternative has the lowest risk of future impacts from mineral development.

Consequences to wildlife from management of livestock grazing

Livestock grazing has declined on the Forest in the last several decades. The action alternatives (B, C, and D) include standards and guidelines for the grizzly bear that limit consequences from future livestock grazing. These plan components provide benefits for all wildlife species that may be affected by reduction of forage in grass/forb/shrub habitats and provide benefits to birds that are susceptible to cowbird nest parasitism or predation within about a mile of livestock concentration areas.

Consequences to wildlife from management of lands and special uses

Land ownership adjustments are one of the tools used to simplify and improve management of NFS lands, including wildlife habitat. Special use permits authorize the occupancy and use of NFS land by private individuals or companies for a wide variety of activities, such as roads, utility corridors, communication sites, and other private or commercial uses, that cannot be accommodated on private lands. All alternatives have plan components for special uses that are designed to coordinate special uses with the needs of wildlife.

Consequences to wildlife from management of economic and social uses and partnerships

Development of all alternatives and plan components considers ecosystem services and multiple uses provided by NFS lands. Plan components are intended to manage these uses in ways that are compatible with the needs of wildlife. Partnerships are vital to an all-lands approach to management. Cooperating with other federal agencies, tribes, state agencies, counties, universities and other non-government organizations helps to increase knowledge of the Forest's wildlife and their needs, promotes sustainable wildlife populations and habitats (including habitat connectivity), helps mitigate threats or stressors, and helps provide social, economic and ecological conditions that contribute to mutual objectives.

3.7.7 Terrestrial Invertebrates

Invertebrates are animals without a backbone. They are cold-blooded, meaning their body temperature depends upon the temperature of their surrounding environment. They include such animal groups as insects, mollusks, crustaceans and arachnids (i.e., spiders). There is a high level of uncertainty with regard to invertebrate populations. There are many areas where their populations have not been surveyed or that have not been surveyed recently (also see section specific to pollinators below). MNHP prepared a comprehensive field guide for snails and land slug of Montana (Hendricks 2012) and stated that species richness of Montana land mollusks is higher west of the Continental Divide; including 42 known native mollusks.

Key Indicators for analysis for most terrestrial invertebrates

The needs of most terrestrial invertebrates would be met by the plan components for diverse ecosystems and key ecosystem characteristics, as described in the vegetation and wildlife sections of this DEIS. In addition, the following indicator applies to the carinate mountainsnail; an invertebrate species that are endemic to the Forest.

- Plan components to reduce the risk of activities that may impact talus habitats with known populations of the carinate mountainsnail

Affected Environment

On the Forest, there are two endemic G1, S1 invertebrate species known to occur on the Forest; the carinate mountainsnail (*Oreohelix elrodi)* and the alpine mountainsnail (*Oreohelix alpina)*. According to the MTNHP database, known locations of these mountainsnails on the Forest have been surveyed from 1974-2010 and they are persisting in those locations. The alpine mountainsnail is known from six sites in four counties west of or near the Continental Divide, ranging from 7200 to 9700 ft. On the Forest, the alpine mountainsnail is known to occur only at high elevations within Wilderness areas where there are no known threats. In Montana, there are 29 records of the carinate mountainsnail from five sites west of or near the continental divide in two counties (most from Lake County), ranging from 3600 to 8000 ft. elevation.

Many mollusks, including the moutainsnails, are found under woody debris, within the talus under or on rocks, or in accumulations of leaf and needle litter, or duff. Downed trees and other woody material are used by many invertebrates such as ants and beetles. Long, large diameter wood is generally most important because it can be used by a greater range of species and provides a stable and persistent structure, as well as better protection from weather extremes.

Talus sites with mountainsnail populations may lack forest canopy altogether or occur under an open mixed conifer canopy including Douglas-fir, western larch, ponderosa pine, western redcedar (near streams), with aspen, paper birch and mock orange scattered along the margins of talus slopes. They may occur at higher elevations in drier habitat where snow banks and seeps keep soil moister. Other habitat requirements and food habits are poorly understood (Hendricks 2012).

Stressors under Forest Service control

Land Management: Talus areas inhabited by mollusks are subject to very few stressors. The low-elevation talus areas occupied by the carinate mountainsnail may be affected by timber harvest or fire in the adjacent mixed coniferous forest or by weed spraying along roads. Activities that destabilize talus could also have negative impacts (Hendricks 2003).

Consequences of alternative A

The 1986 Forest plan did not have management direction for invertebrates, but management direction for soils and down woody material helps to protect mollusk habitat.

Consequences common to all action alternatives

Plan components to maintain ecosystem diversity and key ecosystem characteristics should meet the needs of most invertebrates on the Forest, including the mountainsnails. In addition, alternatives B, C, and D include one guideline to protect know locations of the carinate mountainsnail. Guideline GA-SV-GDL-03 states that talus slopes with known populations of the carinate mountainsnail should not be used as a gravel or ornamental rock source and immediately adjacent vegetation should not be harvested or sprayed for non-native invasive weeds, in order to protect this invertebrate species.

Cumulative Consequences

This species is also known to occur in the Mission Range in the Confederated Salish and Kootenai Tribes Mission Mountains Tribal Wilderness, where there are no known threats other than a non-motorized trail (Hendricks 2003).

Pollinators

Affected Environment

Populations: Pollinators include bees, beetles, bats, birds, butterflies, flies, moths, and wasps. There have not been any research studies specifically regarding pollinators in the Flathead Valley and surrounding areas (see Forest Assessment for more details).

Stressors under Forest Service Control

Land Management: USFS land management activities that may affect pollinators include use of pesticides/herbicide for control of invasive species and ground disturbance. Ground disturbance which occurs during vegetation management activities can disturb or remove ground nests and tree or snag nests.

Stressors not under Forest Service Control

There are several stressors on pollinators. Although researchers have not determined the specific cause of pollinator decline, they have developed the following list of pressures that are speculated to cause individual illness and population crashes (see Forest Assessment for more details); including habitat conversion on private lands, malnutrition, pests and pathogens.

Pests and pathogens: Pollinators have their own suite of pests and disease. There is the well-publicized colony collapse disorder that has affected honey bee hives in recent years. Several possible causes have been identified, but none have been identified as the definitive cause of the decline. There is evidence that the colonies go through cycles of collapse, although no causes were identified at the time for those. Current collapses are in the 30 to 40 percent range, which is significant. Mites have been introduced from Europe, as well as gut fungus and viruses, contributing to further declines. The mites are thought to spread viruses between hosts. While these are the effects seen in apiaries, wild bees can also be infected where the two intermix.

Climate change: Climate change can affect the range of pollinators, the range of their food (native plants), the timing of their food (phenology of wildflowers shifting to earlier in the season), and the gap that can exist between them. There is some debate as to whether pollinators shift with their key plant species. Plant species have been observed over the past couple decades shifting spatially toward the poles as well as flowering earlier in the growing season. Some habitats are more affected than others, depending on abiotic factors such as precipitation, photoperiodicity, and temperature.

Consequences of alternative A

The 1986 Forest plan did not have management direction for pollinators, but management direction for soils and snags protect pollinator habitat.

Consequences Common to All Action Alternatives

Plan components to maintain ecosystem diversity and key ecosystem characteristics should meet the needs of invertebrates on the Forest. In addition, alternatives B, C, and D include desired conditions to support pollinators. All action alternatives include desired conditions FW-DC-POLL-01: Plant communities across the forest are composed of a diverse mix of native grass, forb, shrub and tree species, with a diverse structure and pattern across the landscape, providing foraging habitat for native pollinator species, such as Gillette's Checkerspot butterfly, bumblebees, and hummingbirds.

Introduced, invasive plant species can displace rare species through competitive displacement. Indirect impacts include herbicide spraying and mechanical ground disturbance to control noxious weeds once they gain a foothold. Competition from invasive non-native species and noxious weeds can result in loss of habitat or loss of pollinators. There are not many studies on the effects of herbicides to pollinators. While herbicides are sprayed on the forest for the sole purpose of controlling invasive plants, they may also affect native vegetation that is in the path of the herbicide, if not carefully applied, which reduces insect forage. Indirectly, herbicide spraying can kill populations of native pollinators by contaminating nesting materials and pollen resources. Much of the chemical treatment on the forest is restricted to roadsides, gravel pits, landings, trails and campgrounds, so any potential effects are localized to these areas.

Regarding the risk of weed invasion and control of populations, the alternatives would vary in some ways. All action alternatives contain a forestwide desired condition that states "new invasive plant species are treated and populations are contained or eradicated. Integrated pest management approaches are used, including best management practices (BMPs) that limit introduction, intensification and spread due to management activities. Areas requiring re-vegetation use locally adapted, native plant species where feasible and appropriate. Agreements with cooperative weed MAs assist in noxious weed and invasive plants control across jurisdictional boundaries" (FW-DC-VEG-10). Because roads and machinery can be vectors for weeds, alternatives A and D, with its emphasis on a higher level and rate of vegetation management involving use of roads and machinery, would be expected to require the highest level of effort to control weeds. Alternatives B and C would be between these two alternatives.

Standards and guidelines for protection of soil conditions during vegetation management activities would also be beneficial to ground nesting pollinator species by limiting ground disturbance (FW-STD-SOIL-01, FW-GDL-SOIL-01 through 04). Forest plan direction associated with snag and down wood retention would be beneficial to snag and dead-wood nesting pollinator species by maintaining levels of snags and down wood within desired ranges.

Cumulative Consequences

Pollinators are in decline nationwide due to a combination of threats including introduction of non-native species or pathogens, loss of habitat quality or quantity, pesticides, and climate change. Commercially reared bumble bees used in to pollinate crops and plants in greenhouses are infected with parasites that have been imported from other countries. Spread of non-native mites and virus species have severely compromised honey bee colonies and may spread to native pollinators on NFS lands from nearby communities.

Non-native plants grown on private lands, as well as non-native invasive species found on all lands, can also decrease pollinator habitat quality. Although conversion of native plant communities to agricultural lands benefits some native pollinators, it can decrease habitat quality for others. The Forest Pesticides used to protect seeds or kill tree killing insects, or drift of pesticides sprayed on crops on private lands can kill pollinators directly. Precautions are taken with Forest pesticide application to limit drift of spray which limits direct mortality. Pesticides or herbicides can also be harmful in sub-lethal amounts by impeding pollinator foraging ability. Chemicals that do not quickly break down in the environment can be especially harmful.

Climate change is expected to change the composition of pollinator communities, but effects and pollinator ability to adapt to these changes is uncertain. Anecdotal observations have shown that some bee species adapted to warm climates are expanding their ranges northward (http://greatpollinatorproject.org/conservation/major-threats-to-pollintors).

3.8 Fire and Fuels Management

3.8.1 Introduction

Wildland fire includes both wildfire (unplanned ignitions) and prescribed fire (planned ignitions). Fire management includes the strategies and actions used both before and during wildland fire. Management of wildland fire influences whether fire effects create beneficial or negative impacts to values such as water quality, air quality, habitat, recreation areas, or communities. Wildfire management includes a spectrum of responses from protection objectives to resource objectives (see figure 40). Suppression is a management strategy used to extinguish or confine an unwanted wildfire.

Manipulation of vegetation for the purpose of changing the fire characteristics when it burns is called "fuels management". Fuels reduction treatments result in a change in the amount, configuration, and spacing of live and dead vegetation, with the purpose of creating conditions that result in more manageable fire behavior and reduced severity during wildfires.

3.8.2 Wildland fire management

Wildfires that reduce fuels and improve ecosystem conditions are characterized as "managing fires (or portions of them) to meet resource objectives". These fires tend to have effects that are similar or trend toward desired future conditions. Managing wildfires to meet resource objectives is a strategic choice to use unplanned natural ignitions to achieve resource management objectives and ecological purposes. The benefits of managing wildfires to meet resource objectives may include reducing fuels so that future fires burn in that area with lower intensity, lower impacts, and reduced smoke and are more manageable and pose less threat to communities. Benefits may also include creating a diversity of wildlife habitats, cycling nutrients back into the soil, or reducing forest density to favor fire resistant species such as ponderosa pine. Managing wildfires to meet resource objectives allows fire to resume its natural role in the ecosystem under pre-identified objectives and conditions. By allowing this to occur, the results could be a more resilient ecosystem.

Effective management of wildfire addresses the nature of wildfire and its contributing factors, recognizes the positive and negative consequences of fire, addresses uncertainty, and develops responses that reduce the chances of catastrophic losses (National Cohesive Wildland Fire Management Strategy). Forest and fire managers need to manage risk, both short and long term. If the potential positive and negative consequences of fire are recognized, and management actions to obtain positive outcomes are matched, then in the long term the risk to communities and assets will be reduced; fire will be restored as an ecosystem function to the landscape; and smoke impacts to communities will be reduced.

A wildfire management continuum depicts the relationship of protection objectives and resource objectives as shown in figure 40 below. The continuum demonstrates how the location and conditions affect the management of wildfires or portions of wildfires. To interpret the continuum, consider the four dimensions of length, width, color, and teeth.

The **length** (side to side) of the continuum shows the spatial component or the location where you are on the landscape. It also affects the mix of objectives: on the left, the location favors protection objectives and on the right, the location favors resource objectives.

The **width** (up and down) of the continuum illustrates the different social, ecological or environmental conditions affecting the mix of objectives that can be met from a wildfire. On the top edge, protection objectives prevail. On the bottom edge resources objectives are easier to meet.

The **colors** depict the range of objectives, taking in the combination of both location and conditions. Red (upper left) represents where the combination of conditions and landscape location can cause higher risks to communities or ecological resources, which result in protection as the predominate objective. Green (lower right) has the combination of low-risk conditions and landscape location that make managing for resources the primary objective. The colors also represent the net value change to natural resources and community assets; red indicates a negative change (damage) while green indicates a positive change (benefit). The fire management response is to protect from potential damage and to obtain benefit. As risk is lowered on the landscape, more positive net value change opportunities exist over more locations and conditions, so the ratio of blue to red would increase.

The **teeth** on each end of the continuum display that it wraps around to form a cylinder. A wildfire on the far right could be near an area with high risk and management of that portion of the fire would be to meet protection objections. As fire management decisions reach the dotted line on the continuum, there are added considerations. Focusing only on protection can put people at risk while solely focusing on obtaining resources benefits can bring management risk to fire managers and decision makers.

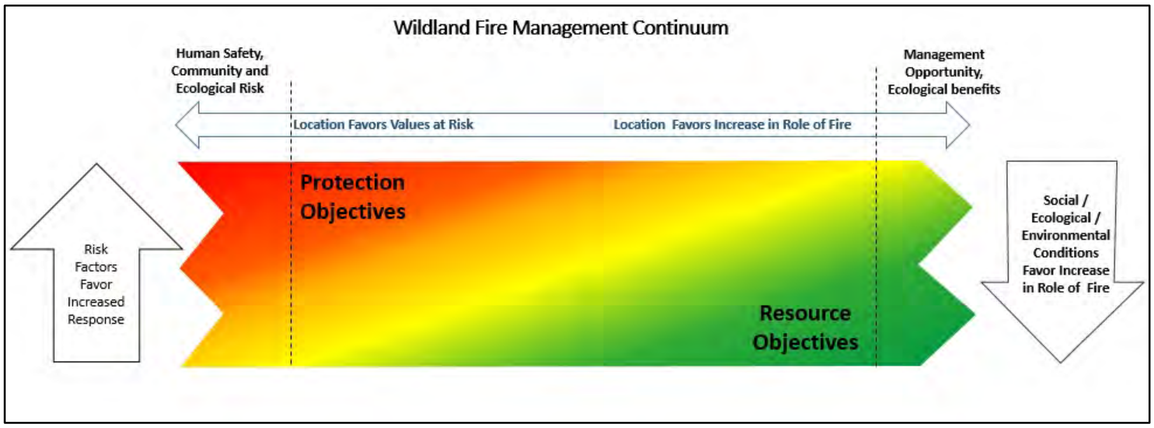


Figure 40. Wildfire management continuum

All wildfires are managed on a continuum between meeting protection objectives and resource objectives, and the mix of these objectives are based both on the location of a wildfire (or a portion of) and the condition in which it is burning under. These objectives come from the forest plan mainly in the form of desired conditions. The burning conditions change through the season and from year to year, providing both the opportunities and the restrictions.

Forest Service policy dictates that every wildfire has some aspect of a protection objective in a fire management response (2015 Interagency Standards for Fire and Fire Aviation Operations). This response can vary from monitoring the fire under conditions that are conducive to obtaining resource benefits to an aggressive suppression effort to protect communities and natural resources from potential damages. Human-caused wildfires require a direct and aggressive suppression strategy.

Wildfires are not allowed to just burn; firefighter and public safety, risk to property, fire management resource availability and national/regional priorities, costs, and potential resource benefits are all factors in all wildfire management decisions.

Fire on the landscape is considered a natural process and many fires on the Forest are started by lightning. However, humans have also been a source of fire on the landscape for centuries, and intentional or not, have influenced vegetation successional dynamics. Fire is not a simple process, and many factors influence its character, including fuel loadings, climatic and weather conditions, topography, vegetation structure and composition, and elevation.

Fires on the forest generally move from west to east with prevailing winds. Dry cold fronts also produce northwest wind flows that move fires from northwest to southeast. Without wind as the driving mechanism, terrain and diurnal temperature changes are large influences on fire movement. Fire generally moves uphill faster than downhill.

For each alternative a wildfire continuum graphic is provided with the percentages of each management area and how they would fit on the graphic. This will facilitate qualitative comparison of the alternatives.

Fire suppression

The successful suppression of wildland fire is dependent on many factors; fuels, weather and topography, suppression resource availability, or time of year. The alignment of these factors (e.g. hot, dry, windy, August) created the remarkable events of 1910, 1929, 1988, 2003, 2007 and 2015. When these factors are not aligned (e.g. plenty of resources, cool moist, late season) it is rare, that fires are not successfully attacked. Even with cooperative efforts of local firefighting resources from all levels of government, these remarkable years require significant assistance from outside the area. When national level activity precludes the supplementation of local resources, fires will exceed local capacity and values at risk will be threatened.

3.8.3 Fuels Management

Fuels reduction treatments include prescribed fire and mechanical treatments. Prescribed fires are fires intentionally ignited by management actions in accordance with applicable laws, policies, and regulations to meet specific objectives. Mechanical treatments include the use of equipment, such as feller-bunchers, to perform activities that change vegetation composition and structure and alter fuels to reduce hazard. Mechanical treatments are often followed up with prescribed burning.

Fuels reduction treatments result in a change in the amount, configuration, and spacing of live and dead vegetation. The costs, environmental impacts, and effectiveness of different fuel treatment types vary. A desired outcome of fuels treatments are more manageable fire behavior and reduced severity during wildfires. Additional benefits include minimizing impacts to values at risk, and reducing fire spread to other ownerships. Strategically located fuels treatments would also provide more opportunities to proactively manage the size and costs of future wildfires. In addition to modifying fire behavior, fuels treatments can achieve multiple resource benefits, such as producing timber products, creating desired wildlife habitat, and contribute to meeting desired vegetation conditions.

As the public moves into the wildland-urban interface they have entered a vegetation matrix that will carry fire when the conditions permit. The wildland-urban interface designation affects all fire management decisions in those interface areas. While a wide variety of fire management strategies are available to implement, these options are usually narrowed down due to concerns that fire may move from federal to private lands. Hazardous fuels treatments in the wildland-urban interface are focused on manipulating the vegetation to enhance the success of fire suppression activities. The focus of fuels management since 2001 has been to modify the fuel conditions to meet varying objectives to reduce threats to values at risk; increase suppression success by minimizing crown fire likelihood, decrease fire intensity, or decrease rate of spread.

3.8.4 Legal and Administrative Framework

Law and Executive Orders

- Wildfire Suppression Assistance Act of April 7, 1989 (HR 4936)
- Healthy Forest Restoration Act of 2003 (HR 1904)

Other Regulation, Policy, and Guidance

- The National Fire Plan (USDA Forest Service 2000)
- The Healthy Forest Initiative
- Interagency Rx Fire Planning and Implementation Procedures Guide 2014
- Guidance for Implementation of Federal Wildland Fire Management Policy 2009
- National Cohesive Wildland Fire Management Strategy (2014)
- Interagency Standards for Fire and Fire Aviation Operations (2015)

3.8.5 Methodology and Analysis Process

Fire is a primary natural disturbance process within the Flathead ecosystems that changes vegetation conditions. Fuels management consists of management activities designed to alter vegetation conditions to achieve desired results. Therefore, the analysis process for determining vegetation conditions, past, present and future, provide the basis for the analysis of fire and fuels treatments within this section of the EIS. This process is briefly discussed below. Please refer to the Vegetation section of this DEIS and appendix 2 for greater detail.

The vegetation management strategy for the Flathead is to manage the landscape to maintain or trend towards vegetation desired condition. Modeling was used to estimate extent and effects of disturbance processes (such as fire) into the past (to develop a natural range of variation) and into the future (to project future wildfire under a suppression scenario). Fire (planned and unplanned), insects (e.g. bark beetles), disease (e.g. root disease), and harvest treatments are the main drivers of vegetative change, interacting with climate and the process of vegetative succession. The main analytical models used were the SIMPPLLE model (SIMulating Patterns and Processes at Landscape scaLEs) and the Spectrum model.

The SIMPPLLE model was used in the forest plan revision for two purposes: to calculate Natural Range of Variation (NRV) for vegetation conditions and to project the landscape conditions of the alternatives into the future for analysis in the EIS. SIMPPLLE takes a landscape condition at the beginning of a simulation (including past disturbances and treatments) and uses logic to grow the landscape through time, while simulating processes (growth, fire, insects, etc.) that might occur on that landscape during the simulation, accounting for the effects of those processes. Simulation timesteps are ten years, and simulations are made for multiple timesteps. To calculate NRV, conditions back to AD 960 were modeled. To estimate future conditions, simulations were made for five decades into the future. The logic assumptions in the model come from a variety of sources, including expert opinion, empirical data, modeled data from other forestry computer applications such as FVS, and from initial model logic files that reflect a long history of trial-and-error and research that has been maintained and documented in files that are passed from forest to forest.

Spectrum was used to project alternative resource management scenerios and schedule vegetation treatments into the future. Management actions are selected to achieve desired goals (objectives) while complying with all identified management objectives and limitations (constraints). Spectrum makes it possible to display management actions to landscapes at multiple spatial and temporal scales. The action alternatives were modeled with an objective based on achievement of desired conditions, as described in the plan, for forest composition and size classes. Limits associated with budget levels are also evaluated.

The Spectrum and SIMPPLLE models are used interactively to analyze vegetation conditions. Wildland fire disturbances are first modeled in SIMPPLLE. Resultant disturbance levels are then input into the Spectrum model as acres of projected wildland fire. The Spectrum model is then run and the outputs from Spectrum are input into the SIMPPLLE model to allow for integration with the ecological processes and disturbances as modeled within SIMPPLLE (fire, insect, disease, succession) and spatial analysis of the change in vegetation conditions over time.

Out of necessity, the models simplify very complex and dynamic relationships between ecosystem processes and disturbances (such as climate, fire and succession) and vegetation over time and space. Though best available information, including corroboration with actual data, professional experience and knowledge, is used to build these models, there is a high degree of variability and an element of uncertainty associated with the results because of the ecological complexity and inability to accurately predict timing/location of future events. These models are tools that provide information useful for understanding vegetation change over time and the relative differences between alternatives. The models are not intended to be predictive or to produce precise values for vegetation conditions. Appendix 2 and planning record exhibits provide detailed information on model development and results.

3.8.6 Information Sources

The vegetation analysis process, which incorporates fire and fuels management activities, uses a variety of data sources, including the use of analytical models. Please refer to the Vegetation section of this DEIS and to appendix 2 for detailed information on information sources. Historical data sets and records for fire starts and acres burned were used to help develop model assumptions and logic.

Incomplete and unavailable information

Terrestrial ecosystems are highly complex and contain an enormous number of known and unknown living and non-living factors that interact with each other, often in unpredictable ways. For this reason, we acknowledge that there are gaps in available information and knowledge about ecological functioning, and an inability to even evaluate what those gaps may be. This gap in our information may lessen over time as new information or methodology is devised. Our ability to predict fire or other disturbances into the future is limited, and is subject to uncertainty. The level of uncertainty depends on how predictable such factors as natural disturbances, climate change, or human caused influences may be.

3.8.7 Analysis area

The affected area for the fire and fuels management effects is the lands administered by the Forest as well as lands of other ownership, both within and adjacent to the Forest.

3.8.8 Affected Environment (Existing Condition)

Historical wildfire natural range of variation

The 2012 Planning Rule emphasizes managing the forests to promote ecosystem integrity and resilience (2012 Planning Rule Directives, FSH 1909.12, Chapter 20). Evaluation of the natural range of variation (NRV) for ecosystem components is recognized as important for providing insight into the structural and functional properties of a resilient ecosystem. The NRV was estimated for the key vegetation components identified for the Flathead, using models to quantify NRV for vegetation composition, forest size class and forest density. For the Flathead analysis, vegetation conditions back to AD 960 were modeled. This reference period allowed us to simulate the conditions associated with much of the time period known as the Medieval Climate Anomaly (MCA) (about 950 to 1250), when climate was warmer on average, as well as the other end of the climate spectrum known as the Little Ice Age (early 1300s to about 1870s), when climate was cooler on average. The inclusion of the MCA in the simulation is potentially valuable in that it might indicate conditions and processes that could occur in the modern climate regime (Calder et al, 2015). The model was run under a scenario that assumed only natural ecological processes and disturbances (fire, insect, disease), and their interaction with climate. Thirty simulations were run to better capture the variability and uncertainties associated with disturbance events and resulting vegetation change. Please refer to appendix 2 and associated documents in the planning record for details as to how the model inputs were developed, what climate indices were used, and other information on the NRV analysis.

The NRV analysis for wildfire on the Flathead suggests the pattern of fire varied widely in extent, size and pattern over time, closely tied to variations in climate. The model simulations reflect the reasonable assumption that under warmer climate periods drier conditions would also occur, and a higher amount of fire could be expected across the landscape when compared to normal climatic periods. Historically, the Flathead was dominated by stand replacement fire, which would kill most of the trees. Mixed, or moderate, severity fires would also occur, with more variable mortality patterns, but where at least 40% of the trees would be killed within the fire boundary. The NRV for stand replacing fire occurring within a decade is estimated at about 3 to 13% of the forest. Low severity fires were the least common fire type on the Flathead, occurring primarily in the dry valley bottom and foothill forests that historically were dominated by ponderosa pine, and to lesser extent Douglas-fir. Deliberate ignitions by Native Americans were also common in portions of the Forest, such as the Flathead and Swan valley bottom lands and foothills. The NRV for average area burned on Flathead Forest lands at any fire severity on a per decade basis (one timestep in the model equals one decade) is estimated to be 3 to 13% of the forest (about 80,000 to 330,000 acres). The minimum area burned was as low as 0.5% (about 20,000 acres) in a decade, and the maximum area burned was as high as 28% (about 670,000 acres) in a decade. Most (at least 75%) of these fires were stand replacement, with the remainder mixed (i.e., moderate) severity. A relative low (3%) of the historical fire was estimated to be low severity. Refer to the planning record for graphs that display the NRV as estimated for wildfire.

Recent wildfire history and trends on the Forest

Wildland fire burned approximately 1,230,000 acres from 1889 to 1930 (see figure 41) in the vicinity of the Forest. The trend of large fires decreased between the 1930s and 1980s, and then increased again starting in 1988. This cycle has many influences; fuels, weather (daily, monthly and long-term), ignition sources and suppression efforts. The lull in the cycle is likely the combination of reduced fuels from the earlier high fire cycle, the peak of staffing lookouts that likely occurred in 1940 (Shaw 1967), increasing capability of technology (e.g. air tankers, dozers etc.), and agency focus on suppression. Historic fire occurrence data from the Forest Fire Atlas has been summarized, showing lightning and all other causes in figure 42. Overall, with the exception of 1940, there is general consistency through the years around the cumulative average of 69/fires/yr. Recent increases in large fires also can be attributed to changes in National Wildland fire policy since 1980, the recognition and implementation of the role of fire on the landscape, and integration into the management of the Forest wildfire program.

Figure 41. Forest total acres burned 1889-2015

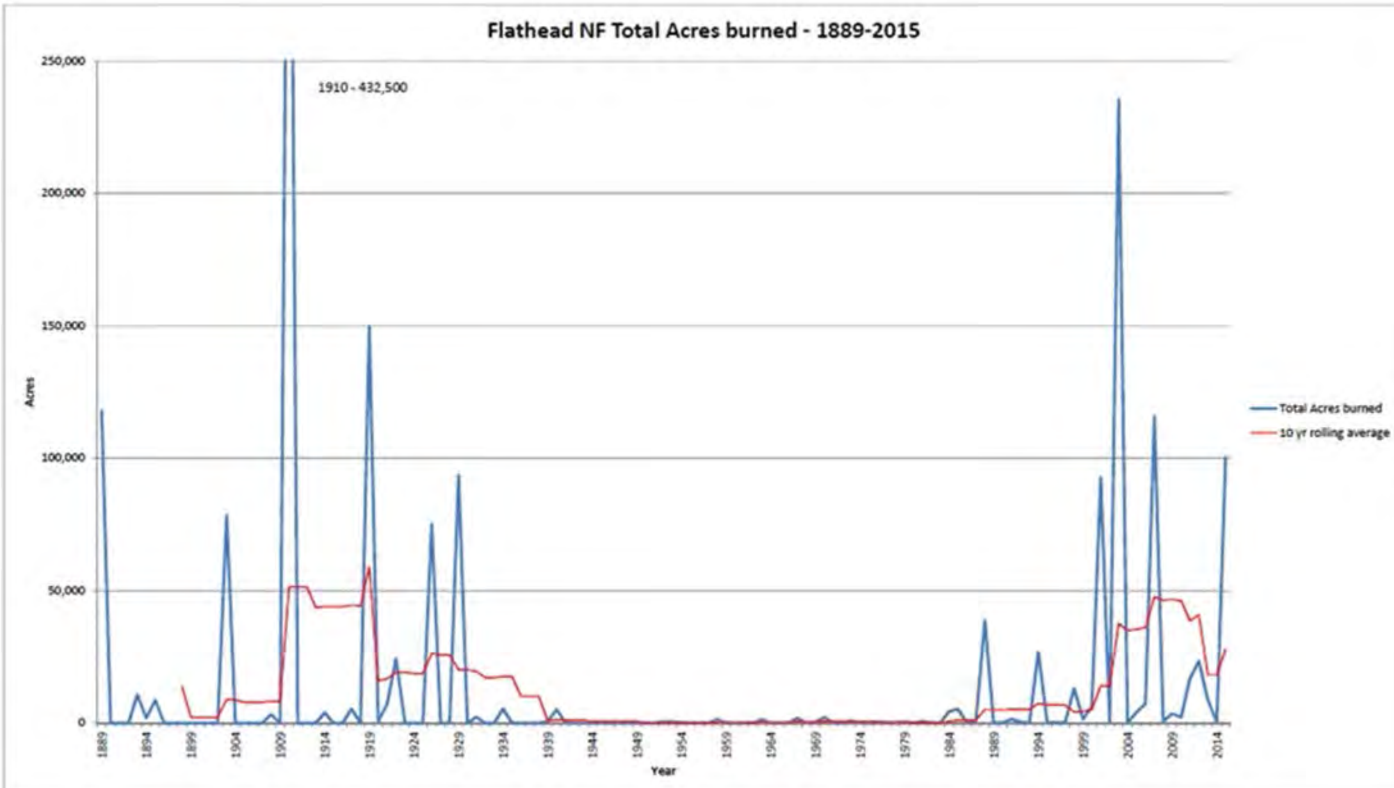
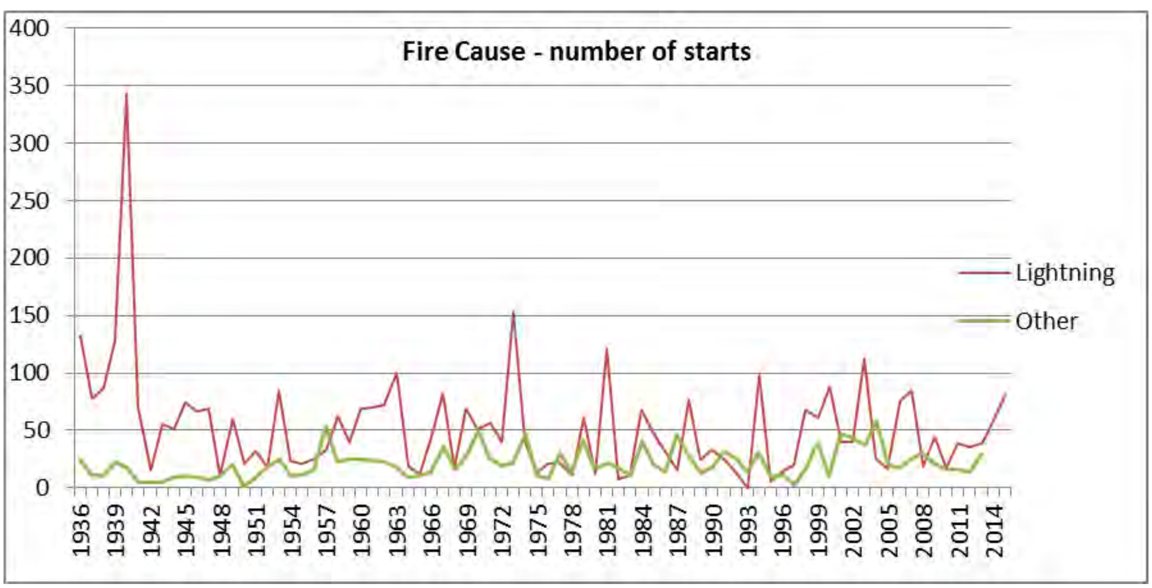


Figure 42. Fire cause-number of starts (1936-2015) from fire report records



Lightning is the dominant ignition source on the Flathead with an average of 45 starts/yr. All human caused starts combined for an average of 24 fires/yr.

These figures together, lead to a conclusion that the large fire events of the late 1800s and early 1900s burned and reburned pieces of the landscape, producing a landscape that required time to regenerate into stands that would generate the fire events we are currently seeing. In addition, climate during the 1940s to 1990s was not conducive to many large fires. As outlined in the Forest Plan Assessment much of the Forest landscape is in fire regimes that are the 35-100 year or longer fire frequencies, which would match up with the fire events of the last 140 years (see the Assessment, pg 61).

3.8.9 Environmental Consequences

Expected future fire trends

Fire has been a fundamental part of the Northern Rockies forests for thousands of years, whether naturally ignited (i.e., lightening) or human induced (i.e., by Native Americans). Fire, fuels, and climate are closely inter-related. Natural, long-term variations in temperature and precipitation patterns have resulted in continuously changing fire regimes (Whitlock et al. 2008), and thus continually changing forest conditions. This past climatic variability has had major effects on the timing, frequency, intensity, severity, and extent of wildland fires, as would potential future changes in climate. The effect may be due to direct climate-related factors, such as increased temperature and greater drying of forest fuels; or indirectly, related to potential changes in forest composition and structure due partly to climate change (refer to the Assessment sections: Terrestrial Ecosystems: Key Ecosystem Characteristics section, “Vegetation Dominance Types” and “Forest Size Classes” subsections). These climate-induced changes in fire regimes could have substantial impacts on ecosystems, with associated effects to communities and economies (McKenzie et al. 2009). It is readily apparent that vegetation, fire, climate and weather are closely interconnected, and the relationship between the multiple aspects of each is extremely dynamic and complex.

A recent comprehensive synthesis of the science surrounding climatic change and ecosystems (USDA 2012) concluded that all fire regimes in western forest ecosystems would experience some increase in fire risk. More fires occur in all forests because of longer fire seasons and higher human populations (Peterson, et al. 2012). Fire intensity and severity will probably be higher as well because of more extreme fire weather (i.e. hotter) and higher fuel loadings (i.e., tree mortality, increased forest densities). In moderate (mixed) severity regimes, more frequent fires could convert lands to more of a low severity fire regime, where frequent fires favor more open stand conditions and tree species resistant to fire damage. Increased fire risk and fire sizes in high severity fire regimes could have significant local effects, especially where close to human population centers. Not well articulated in the climate change discussion is that risk also increases because of increased occupation of the wildland environment. Fire has been a component of the landscape for thousands of years, but now we have a “too much fire problem”.

Simulation modeling (SIMPPLLE model) was used to estimate wildfire activity on the Flathead for five decades into the future. Best available information was used to build the fire suppression logic and assumptions within the model, including corroboration with actual data, and professional experience and knowledge. Refer to appendix 2 and associated planning record exhibits for detailed discussion on model development and outputs associated with fire and resulting vegetation changes.

Recognize constraints to fire management

A key consideration of fire management of the Forest is that in general, there are a very large number of burnable acres of NFS lands that can’t be actively managed by mechanical means, and an even larger number that can’t be economically treated with prescribed fire because they are designated as wilderness, where these activities are restricted. Appropriately managing wildfire in places with an opportunity to obtain resource benefits and a low risk of potential damages may be the only way in many areas to increase the pace and scale of ecosystem restoration activities. Informed management of wildfire would also need to be a method to maintain areas once restoration has occurred.

Comparison of all alternatives

The alternatives vary from the fuels management perspective on the allocation to different management areas. The primary management area that impact fuels management is the designated wilderness (MA 1a) by the limitations on both mechanical and prescribed fire application under current policies. In recommended wilderness (MA 1b) initial limitations would be for mechanical treatment of fuels and upon designation likely the reduction is prescribed fire. Additionally, the implementation of the Northern Rockies Lynx Amendment (USFS 2007) severely constrains treatments in Lynx habitat outside the wildland-urban interface where multi-storied hare habitat or stand initiation hare habitat is present.

Model comparison

This section references the output from the SIMPPLLE model and the fire component. Refer to appendix 2 and planning record exhibits for additional details on the modeling process and results.

Fire specific assumptions with for the SIMPPLLE model include:

- Class “A” size (0-0.25 ac) that are suppressed have no influence in the model.
- Suppression rates were based upon the national standards from NWCG resource production tables
- Suppression response time varied from ½ hr. in the wildland-urban interface to 2 days in remote locations.
- Fire may reburn an area if the vegetation becomes conducive to fire spread in future years

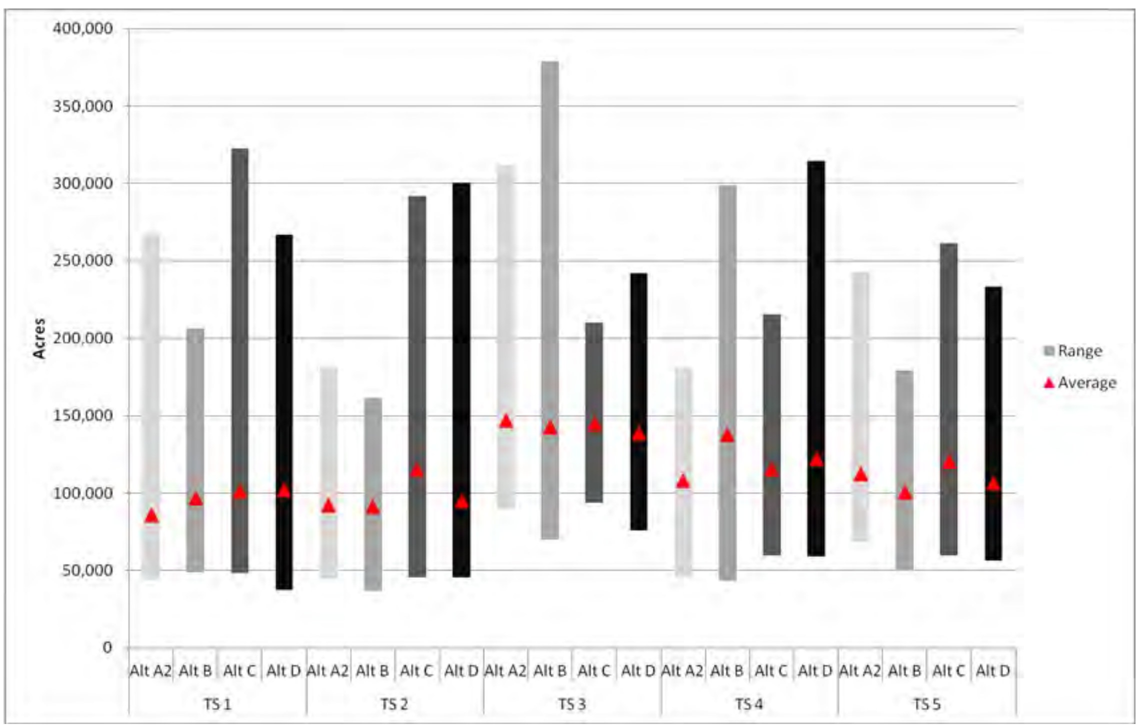


Figure 43. SIMPPLLE model outputs for wildfire acres burned by decade and alternative, across the five decade model period.

The average summary data for modeled wildfire in figure 43 below (the triangles) is segmented by decades (TS = time step of 1 decade) for each alternative. The graph shows the average acres burned for all alternatives in the first two decades increases compared to the 50,000 acres from the 10 year average line in Figure 2. The increase in acres burned in the third decade is related to the shift to warmer (drier) climate period. The range bars also follow similar trends in actual fire occurrence the historic data.

Using the wildfire continuum as a metric for comparison of the overall intent of each alternative, the alternatives generally fall along the spectrum from protection to resource objectives as illustrated in figure 44 below. This is based upon the how each alternative allocates the landscape to each management area. The primary driver is the amount of wilderness and proposed wilderness.

The alternatives also vary on the management area allocation that occurs within the wildland urban interface as it currently exists. These changes influence the type of treatments that may be utilized to manage vegetation. Below in table 60 is a comparison of alternatives and grouped management areas. The management areas are grouped by similar types of management implications within the wildland-urban interface. Each alternative's acres total to the 405,184 acres of wildland-urban interface on the Forest.

The primary wildland urban interface data was created from the Flathead County Community Wildfire Protection Plan, the Whitefish Community Wildfire Protection Plan, and the Seeley-Swan Community Wildfire Protection Plan. Each analysis incorporated not only communities at risk as defined in the Healthy Forest Restoration Act of 2003 (P.L. 108-148), but also other values such as dispersed infrastructure, powerlines, high density "neighborhoods" not within a defined community. Also the wildland-urban interface incorporated some analysis of potential fire behavior and likely fire spread that would threaten these values.

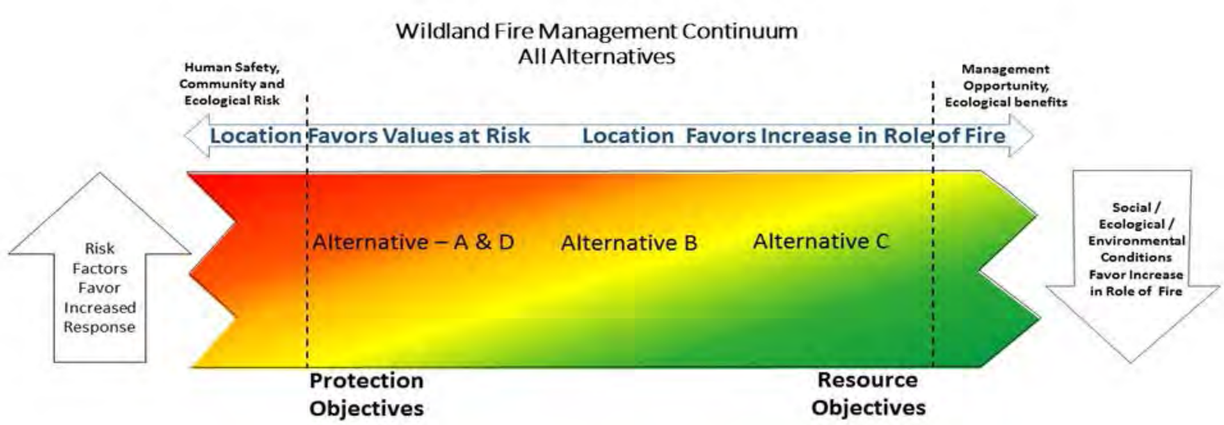


Figure 43. Position of all alternatives on the wildfire management continuum chart.

Table 59: Acres of wildland urban interface by management area (MA) group and alternative

Management Areas	Alternative A	Alternative B	Alternative C	Alternative D
1a, 1b	19,888	20,662	72,939	15,858
2a, 2b, 3a, 3b, 4a, 4b	22,934	29,897	28,223	29,977
5a, 5b, 5c, 5d	64,302	40,946	17,042	40,419
6a, 6b, 6c, 7	298,060	313,679	286,980	318,929

Alternative A – No Action

Management direction for alternative A – no action

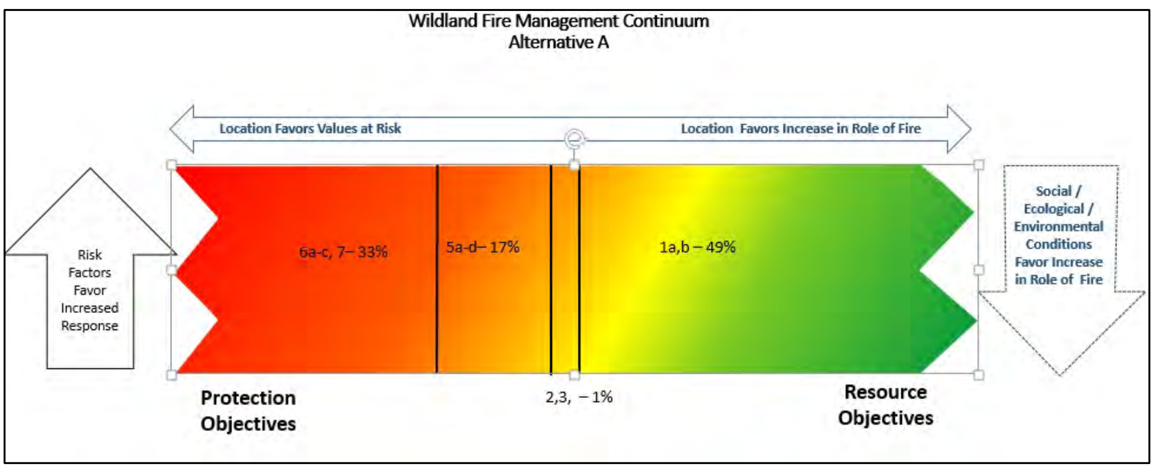
Current direction for fire management emphasizes suppression. The Forestwide Resource Goal 11 states "Improve local knowledge of native succession and disturbance regimes, and resulting landscape dynamics. Apply this knowledge in developing desired future landscape patterns and ecological process for individual landscapes and watersheds." Page II-5. Vegetation Objectives (page II-9) at the landscape-level also identify the following:

- Manage landscape composition and patterns to reduce the risk of undesirable fire, insect and pathogen disturbances.
- Where fuel conditions and potential fire regimes have been significantly affected by fire exclusion and timber management, manage landscape fuel conditions (amounts and spatial arrangement) to restore the historical fire regimes and reduce the risk of undesirable fire events. Emphasize this objective in areas where wildlands interface with urban and rural areas of private property.

Currently, 17 of 25 management areas have no flexibility for fire management and require full suppression under all conditions. During years when the fire season is expected and evolves into a "below" average year for fire conditions (e.g. 2014) fires that could mitigate fuels concerns and maintain fire regimes in these management areas are suppressed (see Figure 6). Thus fire response is constrained by the plan direction instead of the conditions on the landscape.

With alternative A, 518 miles would need to be reclaimed, and either on the transportation system as impassable or off the transportation system as decommissioned. This would lead to increased response time for wildfires and increased costs for prescribed fires. Reduced access would also impact the ability of the Forest Service to use mechanical treatments in the future that this access would have facilitated.

Figure 44. Alternative A: Wildfire management continuum chart with management areas



The wildfire continuum shown in figure 45 portrays the percentage of management areas as cross walked into the categories of the new management areas in the DEIS. The wildfire continuum graph depicts the constraining objectives by the changes in to colors for management areas. Note that even in management areas designated wilderness and recommended wilderness (MA 1a & 1b) there are overlapping areas of wildland-urban interface that likely will cause fires to be suppressed due to proximity and conditions. This has been the case in recent years. The acres available for treatment in backcountry and general forest (MA 5a-d & 6a-c) from table 60 has approximately 362,362 acres, which is second to alternative D.

The effect is that fires will continue to be suppressed under all conditions in general forest, backcountry and focus recreation (MA 6a-c and most of MA5 and 7), which will likely lead to continued increase in hazardous fuel conditions with this eventually leading to larger fires that will be difficult to contain.

Alternatives B, C, and D

Effects of forest-wide direction

All the action alternatives contain desired conditions and guidelines that articulate what the role fire should play. Management direction recognizes that risks to important values changes dependent upon the seasonal changes in weather and fuels, providing the opportunity to use fire as a management tool when conditions are conducive to meeting various plan objectives. The revised plan recognizes that with certain weather, fuels, and topography fires can be managed with minimal risk to values. The acres of each management area influence how fire management can be implemented for each alternative.

Management direction for alternative B

As shown on the wildfire continuum chart, there is an increase in acreages in designated wilderness and recommended wilderness (MA 1a & 1b) and a decrease in General Forest and Focused Recreation (MA 6a-c and 7) compared to Alternative A. Also in General Forest and Focused Recreation there is “more” green demonstrating some potential for management of fires other than keeping them as small as possible. These opportunities would be based on the pre-season conditions and then a decision once a fire starts, to take into account actual fuel, time of season, current, and expected weather (see appendix C for examples of strategies). The intent of fire management is that fires grow in size within shorter timeframes and spatial extent, risks for positive effects are high, and negative impacts are low. The impact of increased acres of recommended wilderness may influence the ability to mechanically mitigate fuels to meet the Forest Objective (FW-OBJ-FIRE-01) to use mechanical treatments on the landscape.

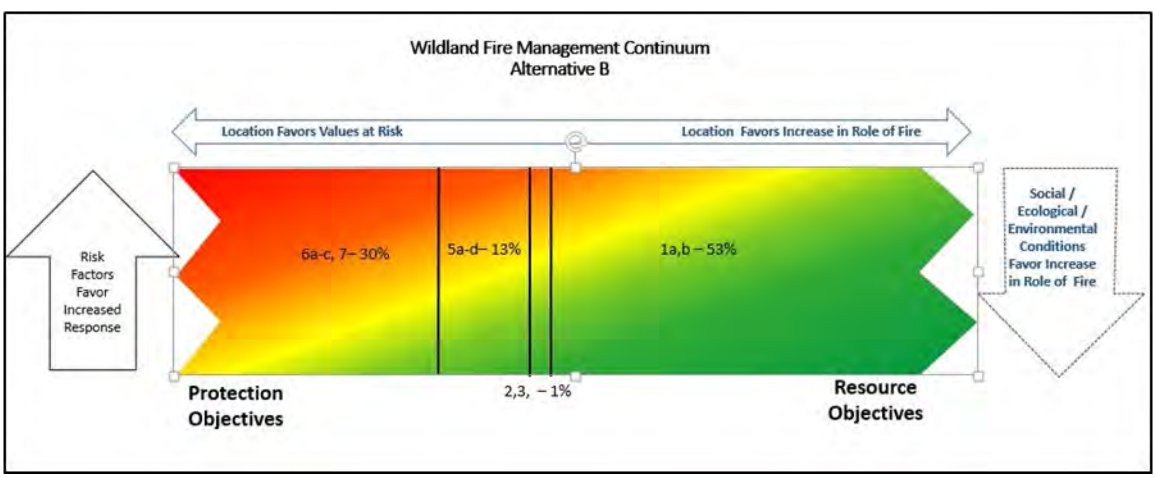


Figure 45. Alternative B: Wildfire management continuum chart with management areas

The wildland-urban interface acres available for treatment Backcountry and General Forest (MA 5a-d & 6a-c) (see table 60) are approximately 354,625 ac. Compared to alternative A there is a 10 percent decrease in acres.

Management direction for alternative C

Alternative C has most acres in designated wilderness and recommended wilderness (MA 1a & 1b). The expectation is that the wildfire is utilized more frequently to meet resource objectives, with an emphasis on non-mechanical treatments on these acres. There would be limitations on ability to utilize other means of either mechanical or prescribed fire in these areas especially when proposed wilderness becomes designated.

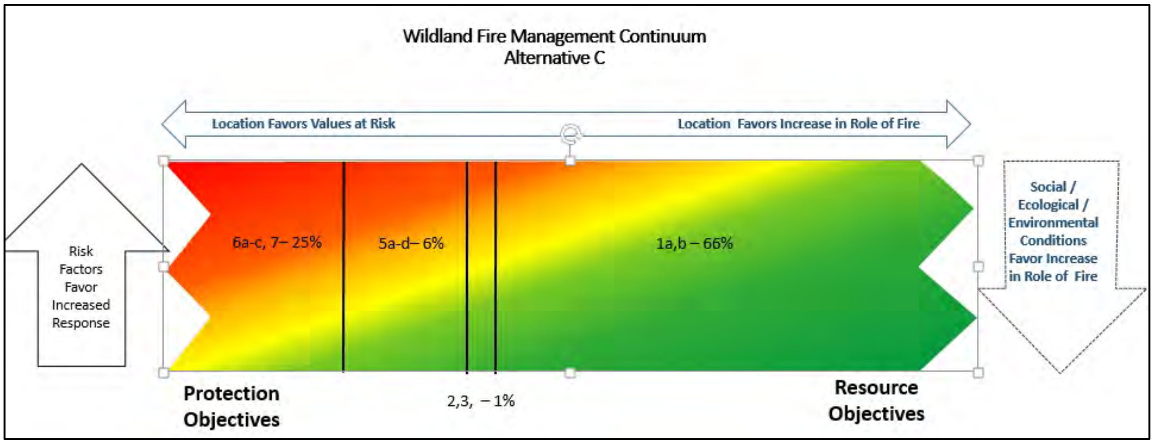


Figure 46. Alternative C: Wildfire management continuum chart with management areas

However, this would be dependent upon the use of unplanned ignitions and the risk assessment associated with each season and event that may require suppression actions instead. With the focus on natural role of fire the use of prescribed fire could be expected to be less relative to alternatives B & D.

The wildland-urban interface acres available for treatment Backcountry and General Forest (MA 5a-d & 6a-c) from Table 60 has approximately 304,022 ac. Compared to Alternative A there is a 17 percent decrease in acres. This alternative provides potentially the least opportunity to treat wildland-urban interface acres.

Management direction for alternative D

Alternative D provides for the most flexibility for fire suppression across the forest with the reduced recommended wilderness and the increased opportunities/focus of mechanical treatments. Future development of motorized road and trail access would be less restricted. Compared to natural fire and unplanned ignitions alternative D would likely result in less amounts of prescribed fire because treatment could be allocated to mechanical treatments instead.

The wildland-urban interface acres available for treatment Backcountry and General Forest (MA 5a-d & 6a-c) from Table 60 has approximately 359,349 acres. Compared to Alternative A there is a slight 1 percent decrease in acres. Alternative D provides the most opportunity to treat wildland-urban interface of the action alternatives.

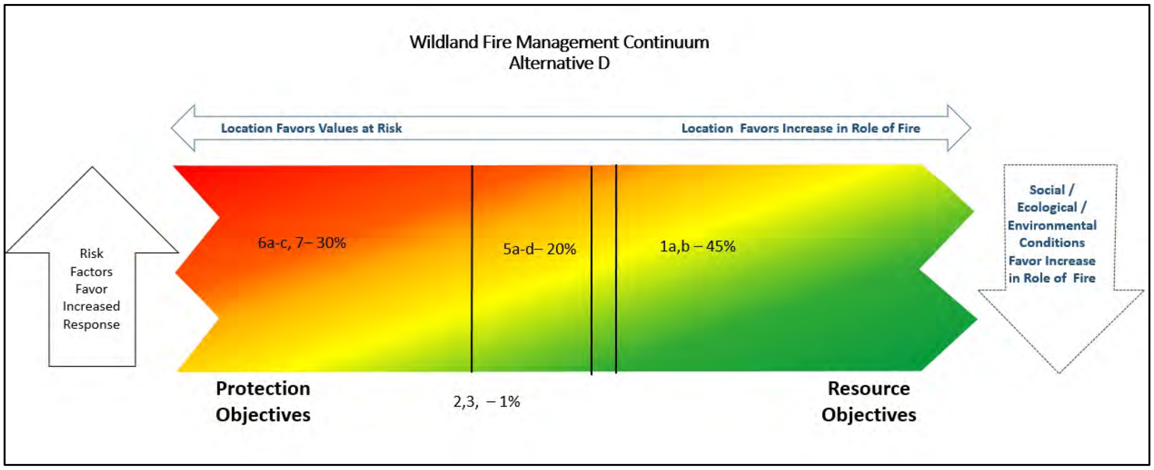


Figure 47. Alternative D: Wildfire management continuum chart with management areas

Summary of Effects of Management Area Direction

Relative to the current Forest Plan, the alternatives would emphasize the need to treat fuels and lower wildfire risks where values at risk are the greatest, which changes through time. The hazardous fuels treatment objectives would be emphasized where the risks are greatest within the project areas. Coordination with adjacent landowners would enhance hazardous fuels reduction on a greater number of acres.

Effects of Geographic Area Direction

Salish Mountains

Alternative C changes acres for General Forest High to Moderate to give more consideration to connectivity and retention of greater amounts of cover. Harvest methods would include less regeneration harvest or a slower rate of harvest. However, this may produce fuels concerns along the eastside in the Tally Lake area. Given the proximity to private property, highway, railroad and other infrastructure this could be a challenge to manage fuels and suppress fire.

Swan Valley

In Alternative A, about 518 miles would need to be reclaimed, and either on the transportation system as impassable or off the transportation system as decommissioned, forestwide with most occurring in the Swan Valley GA. This would occur to meet grizzly bear management objectives in the existing plan (amendment 19), which would likely lead to fewer opportunities for mechanical fuels projects. This may reduce the opportunity or increase the complexity for prescribed burning without pretreatment in some locations. It may also increase response time. Under Alternative C the allocation to General Forest – Low (MA 6a) may impact the ability to treat along the wilderness boundary for fire management purposes.

Consequences to fire from forest plan components associated with other resource programs or revision topics

*Effects **from air quality management***

The consequences to fire from air quality are the same for all alternatives. All alternatives have the same Plan components to meet air quality standards established by Federal and State agencies. The Forest Service would meet the requirements of state implementation plans and smoke management plans. Fall valley inversions have constrained the Forest Service's ability to implement prescribed burns. The expectation is that this will continue into the future. The Simpplle model runs do not take this into account, so the model outputs over predict the amount of prescribed acres likely burned in any decade.

Effects from timber management

Vegetation treatments are typically designed and implemented to achieve multiple resource, social and economic objectives, including those associated with fuels management. Where fuels reduction is an identified objective, the timber management program supports the accomplishment of that objective.

Under Alternative A, the existing forest plan directs the suppression of all wildfires in the Management Areas where timber production is an objective. All Action Alternatives do not have this limitation, but recognize that not all fire is detrimental to timber production; therefore there is opportunity to allow wildfires to burn and help maintain/restore fire adapted ecosystems.

Effects from access and recreation management

Changes in road access are the most under alternative A, and about the same for alternatives B, C, and D (refer to Recreation and Access section of the DEIS). This would influence fire management activity access and remove it where roads are decommissioned. Alternative means of treating fuels may be more expensive and thus prohibited.

Effects from watershed, soil, riparian and aquatic management

Consequences from Forest Plan components on the ability to restore or maintain ecosystems or reduce hazardous fuels would be generally similar for all alternatives. In order to meet the Plan direction associated with these resources there will likely be occasions where prescribe or natural fires cannot be used due to potential negative effects that those activities could have on these resources. Fuels management activities occasionally require some soil disturbing activities or road construction, which may be limited to meet other Plan components. Although it is difficult to quantify the effects, all the alternatives have components that would limit fire for ecosystem maintenance or fuels treatments in certain circumstances.

Effects from wildlife management

Generally, wildlife management direction has low impact on fire and fuels management within the wildland urban interface, because management direction recognizes the importance of managing vegetation to modify fire behavior. The Northern Rockies Lynx Management Direction recognized the importance of fuel treatments within the wildland-urban interface as a designated by the Healthy Forest Restoration Act (see Lynx section of DEIS chapter 3 for more details). However, opportunities to conduct vegetation treatments, including prescribed fire or mechanical fuels reduction treatments, outside the wildland-urban interface are limited under current lynx management direction. Restrictions on treating within these forest conditions is likely to reduce the ability and effectiveness of achieving desired forest and fuel conditions outside the wildland urban interface, for reasons summarized below (refer also to the Vegetation section of this DEIS).

Lynx management direction restrictions on treatments in multi-story hare habitat and young seedling/sapling forests is most impactive. These forest conditions are widespread and common across the Flathead, due to the dominance of subalpine fir-spruce forests and of fire as a natural disturbance process, creating large areas of seedling/sapling forest. Thinning of dense sapling stands is typically designed to create future forests composed of larger trees and desired species (such as fire resistant western larch). These forests are more resilient in the face of future wildfire events, and may burn less severely, reducing potential future impacts to values at risk. Thinning in these young stands is not allowed under current management direction.

Prescribed fire is often the only feasible management tool available to use across the majority of the Flathead Forest (refer to Table 12). Typically, the objective of prescribed fires is to reduce stand densities by removal of the understory, and in some forest types (such as subalpine fir and lodgepole dominated forests), removal of portions of the overstory to create patches of more open forest conditions across the landscape. Prescribed fire management with these objectives would not be able to occur in multistory hare habitat, limiting the ability to manage landscape patterns and fuel conditions to achieve desired conditions. Use of wildfire (unplanned ignitions) to achieve desired conditions is frequently infeasible outside designated wilderness.

Effects from recommended wilderness area designations

There is an assumption that recommended wilderness areas would be designated by Congress as wilderness at some point in the future. Wilderness designation would result in reduced flexibility and options for vegetation and fuels management to achieve desired conditions. Use of prescribed fire is typically not allowed within designated wilderness areas, and the ability to use unplanned ignitions (wildfire) as a tool would be very limited within some of the recommended wilderness areas. This is because of the small size and/or in locations of the areas and most wildfires would likely have to be aggressively suppressed to protect identified values (i.e., private lands). This effect would be most pronounced under alternative C, with some impact, though much less, under alternative B. There would be little impact under alternatives A and D. For detailed discussion, refer to the Plant Species section 3.5.1 in this DEIS under effects associated with whitebark pine restoration, and the Vegetation section 3.3.11.

Cumulative effects

National Fire Plan, Healthy Forest Initiative, and Healthy Forest Restoration Act

Since they were developed, these national level plans, initiatives, and acts (these are called "other plans" for the rest of this discussion) have influenced the vegetation and fuel management programs on the Forest. Therefore, they have had some effects on hazardous fuels and it is anticipated that they will continue to do so for the foreseeable future. In general, these plans have resulted in more vegetation treatments being implemented in the vicinity of wildland-urban interface areas with the objective of reducing hazardous fuels, and fewer vegetation treatments being conducted in areas located away from communities. In addition, the types of fuel treatments that are being used in response to these other plans are often more expensive, and the social issues (i.e., effects of treatments on scenery, air quality, noise, wildlife viewing, etc.) can be more contentious. Therefore, higher public involvement, planning and implementation expenses are likely to lead to fewer acres being treated within a given budget level. Not only do these other plans emphasize the need to reduce hazardous fuels in the wildland-urban interface, but they also stress the need to restore the natural fire regimes and forest conditions to the larger national forest landscape. These plans encourage the development of more resistant and resilient forest vegetation that would be less susceptible to large undesirable wildfires and/or insect outbreaks.

Climate Change

Of all of the ongoing and foreseeable future actions that have the potential to affect fire, especially unwanted wildfire, climate change is likely to be the single most important factor. The effects of climate change will likely combine with some of the effects that result from implementing the alternatives, to produce cumulative impacts. In general, the fire seasons are expected to become longer, large wildfires are expected to occur more often, and total area burned is expected to increase. By increasing the amount of prescribed fire use, as well as the amount of wildfire use for multiple objectives, the action alternatives would be expected to partially offset predicted effects from the climate change. The more fire use (and mechanical treatments) that occurs as a result of the action alternatives, the greater the fuels will be reduced and the forest vegetation restored to more resistant and resilient conditions, which would mitigate climate change effects. The windows for prescribed fire may be come longer with a warmer climate which may reduce some air quality issues that fall inversions have historically produced.

Human population increases and/or shifts towards wildland-urban interface

For the last several decades there has been more human development occurring around the "edges" of lands administered by the Forest. This trend is expected to continue in the future and is likely to have effects on the forest vegetation that are similar to those discussed above under the item titled "National Fire Plan, Healthy Forest Initiative, and Healthy Forest Restoration Act." In addition, with a greater number of people living and recreating in these wildland-urban interface areas, there is a greater probability of more human-caused wildfire ignitions that could have effects on the forest vegetation, in spite of efforts to suppress human-caused fires.

While working cooperatively with neighboring large land owners on the management of fire and implementing fuels management strategies is effective, it is the small lot owner that becomes the focus of suppression resources when large wildfires occur. The future increase in small lot owners will continue to challenge wildfire management during large fire events. To work individually with these property owners is costly and creates a patch work of defendable properties among those that are not.

The current trend of Rural Fire Department staffing is on the decline, leading limitations on their ability to support fire suppression and/or structure protection in their jurisdictions. This may lead to increased spread of fire from off forest.

Where plan components limit implementation of prescribed fire the ability for fire managers to use this tool for larger landscape fuels management may be compromised.

Increased regulation and concern over smoke emissions

The ability to use fire to maintain and/or restore the fire adapted ecosystems on the Forest, or to use fire to reduce hazardous fuels in the wildland-urban interface, is dependent upon air quality regulations. Therefore, to the extent that air quality regulations may become more stringent in regards to the quantity and timing of smoke emissions, there could be substantial effects on the ability of the Forest fire management program to utilize these fire tools. If past trends of increasing regulations and decreasing burn opportunities continue, the effects could be substantial and would likely result in not being able to use fire enough to make meaningful improvements to forest and fuel conditions and meet objectives.

Timber product manufacturing infrastructure and economics

The ability of the Forest to positively affect the forest vegetation is partially dependent upon the ability to sell forest products to manufacturing companies; and to use the harvesting process (including the residual slash disposal activities) as a means to positively affect the forest vegetation and reduce hazardous fuels. If the forest products industry declines in areas surrounding the Forest to the degree that it is difficult to sell forest products or "stumpage prices" decrease significantly, it would affect how many acres could be treated and fuels reduced. While some treatments could be accomplished by using prescribed burn only treatments, it is generally too risky in the wildland-urban interface and very expensive elsewhere.

Effects Summary

Reviewing the data analyzed, the most significant change in the future from the past is the wilderness acres burned. This is due to the policy shift that has occurred.

Because the fire related plan components are the same across the alternatives the analysis doesn't show significant differences for Fire and Fuels as analyzed, but variation occurs by the allocation of management area designation. The ecological effects show up in the other sections of this document. The changes that are reflected may contribute to the deciding official's final decision.

3.9 Air Quality

Introduction

Air quality is dependent on the type and amount of pollutants emitted into the atmosphere, those that currently exist in the atmosphere, the size and topography of the airshed, and the prevailing meteorological and weather conditions. Sources of pollution within the Forest may include particulate generated from timber and mining operations and prescribed fire. Dust from forest roads may also contribute to fine particulates in the air.

The focus of this discussion is on smoke and how the various alternatives could affect smoke production through the use of prescribed fire, the use of natural, unplanned ignitions to meet resource objectives, or emissions from unwanted wildfires. Of all potential sources of air pollution from management activities that occur on the Forests (e.g., road dust, mining operations, emissions from logging equipment and recreational vehicles), smoke is the most substantial contributor to air quality and visibility. Smoke can exacerbate public health issues as well as reduce the ability to view the scenery on the Forest. However, as discussed in the "Fire and Fuels Management" and forest "Terrestrial Ecosystems and Vegetation" sections of the DEIS, there is strong need to use fire to maintain and restore the fire-adapted ecosystems on the Forests and as a tool to reduce hazardous fuels in the wildland-urban interface (wildland-urban interface).

Legal and Administrative Framework

The Federal Clean Air Act (CAA) of 1955 (as amended in 1967, 1970, 1977, and 1990): The act is a legal mandate designed to protect public health and welfare from air pollution. Although this policy creates the foundation for air quality regulation, states and counties are often responsible for implementation of the air quality standards. The task of identifying National Ambient Air Quality Standards (NAAQS) is assigned by the Clean Air Act to the EPA. The EPA evaluates and updates these standards every 5 years.

1999 Regional Haze Rule (RHR): The 1999 RHR mandates that states address control of man-made air pollution that impacts visibility in designated Class I airsheds (such as the Bob Marshall and Mission Mountain Wilderness areas). The goal of the RHR is to return visibility conditions in Class I areas to natural background conditions by the year 2064

Clean Air Act Conformity: The CAA requires federal agencies to ensure that actions they undertake in nonattainment and maintenance areas are consistent with federally enforceable air quality management plans for those areas.

Prevention of Significant Deterioration (PSD): The CAA requires federal land managers,"…to preserve, protect, and enhance the air quality in national parks, national wilderness areas, national monuments, … and other areas of special national or regional natural, recreational, scenic, or historic value." PSD addresses resource protection through the establishment of ceilings on additional amounts of air pollution over base-line levels in "clean" air areas, the protection of the air quality-related values of certain special areas, and additional protection for the visibility values of certain special areas.

The Montana Ambient Air Quality Standards: The Administrative Rules of the State of Montana, Chapter 17.8, Subchapter 2, Ambient Air Quality, state air quality requirements. Montana's standards are as stringent as, or more stringent than, the NAAQS. Some of MAAQS have different averaging periods or have been converted from concentration units (ppm) to mass units ($\mu g/m^3$) using different standard conditions.

Montana State Implementation Plan: The collection of EPA-approved programs, policies and rules that the State of Montana uses to attain and maintain the primary and secondary National Ambient Air Quality Standards (NAAQS).

CEQ's Revised Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions (CEQ 2014): The guidance explains that agencies should consider both the potential effects of a proposed action on climate change, as indicated by its estimated greenhouse gas emissions, and the implications of climate change for the environmental effects of a proposed action. The revised draft guidance supersedes the draft greenhouse gas and climate change guidance released by CEQ in February 2010, and unlike the 2010 draft guidance, the revised draft guidance applies to all proposed Federal agency actions, including land and resource management actions.

3.9.1 Key indicators

The key indicators are ambient air quality and visibility, specifically:

- An alternative would be considered to have potentially significant impacts if implementing the alternative would result in a NAAQS non-compliance violation as determined by the Montana Department of Environmental Quality (MTDEQ).
- An alternative would be considered to have potentially significant impacts to visibility if implementing an alternative would result in changes to/degradation of visual quality, views, and the aesthetic landscape

The MTDEQ has a network of air quality monitoring sites across the state. Monitoring sites that are within and near to the affected environment include the following:

- Kalispell–Flathead Electric (Revision and NCDE-Amendment Forests)
- Whitefish–Dead End (Revision and NCDE-Amendment Forests)

3.9.2 Methodology and analysis process

A qualitative assessment of smoke emissions and consequences to ambient air quality and visibility was used as the indicators for effects to air quality. The actual quantitative values of smoke and other emissions that would be produced by each alternative are too variable to accurately predict. Therefore, the comparison of alternatives is based on a qualitative assessment of the relative amounts and timing of smoke that may be emitted by the alternatives.

Information sources

Information was obtained from the U.S. Environmental Protection Agency, Western Regional Climate Center, Montana Department of Environmental Quality and Montana-Idaho Airshed Group websites, databases and reports. Additionally information was obtained from Forest Service documents.

Incomplete and Unavailable Information

Quantitative values for smoke and other emissions are difficult to predict. Potential emissions from unwanted wildfires are also difficult to predict as they would vary depending upon site-specific vegetation and fuels conditions, ignitions, weather, and available suppression resources. Emissions from the use of prescribe fire and the use of natural, unplanned ignitions to meet resource objectives is also difficult to predict quantitatively.

Analysis Area

The analysis area or region of influence (ROI), for air quality depends on the specific pollutant(s) and emissions source(s) involved, as well as weather patterns, terrain, and prevailing winds. Primary pollutants are emitted directly; secondary pollutants are formed through chemical reactions in the atmosphere from precursor pollutants. The ROI for a primary pollutant depends on the rate of emissions from a source, the elevation of the source, the type of pollutant, and the meteorological conditions that limit its dispersion and dilution during transport away from the emissions source. The ROI for primary pollutants is an area potentially subject to measureable air quality impacts under unfavorable dispersion conditions and is generally a relatively small area, for example, from 1 mile to less than a few miles from the source. The ROI for a secondary pollutant, for example ozone, that can impact air quality for 100 miles.

The mountains of the Continental Divide influence wind patterns and air quality in Montana and is reflected in the layout of the State's airsheds, shown in Figure 49. For the Flathead Revision the affected airshed is number 2. Airshed boundary descriptions are detailed in the Montana/Idaho Airshed Group Operations Guide (2010).

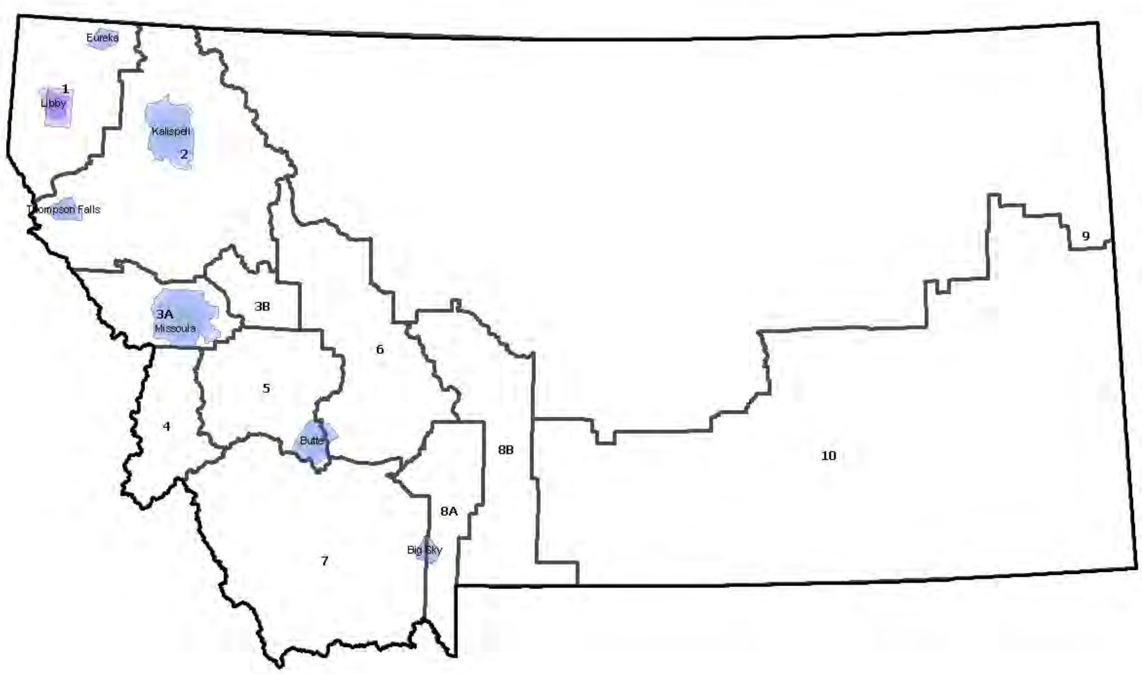


Figure 48. Airsheds of Montana (MT/ID Airshed Group 2010)

3.9.3 Affected environment (existing condition)

Air quality is highly influenced by climate. The majority of the affected environment for the Revision and Amendment PA lies west of the Continental Divide. Here, the climate can be described as a modified north Pacific coast-type where winters are milder, precipitation is more evenly distributed throughout the year, summers are cooler in general, and winds are lighter than on the eastern side of the Divide. There is more cloudiness in the west in all seasons, humidity runs higher, and the growing season is shorter than in the eastern plains areas (Western Regional Climate Center 2015). The annual prevailing wind pattern is shown in figure 50 and described as following a semi-counterclockwise pattern in the affected area.

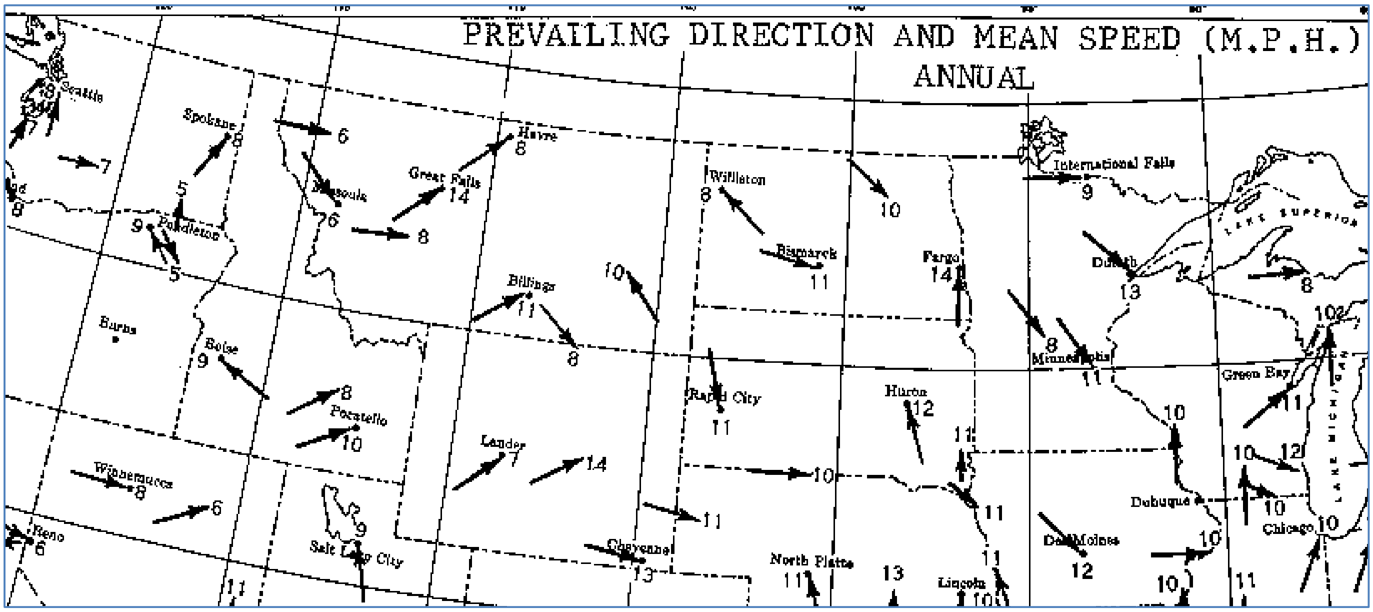


Figure 49. Annual prevailing wind pattern for the affected environment (WRCC 2015)

Pollutants

The EPA defines 6 known air pollutants as criteria pollutants for which NAAQS are set. The most common violation of a NAAQS from smoke is that of the $PM_{2.5}$ standard. Wildfires are considered a naturally occurring event from which smoke impacts may not be prevented. For natural events, state DEQ's are required to have Natural Emergency Action Plans that identifies procedures such as notifying the public of health impacts of smoke and how to decrease and/or minimize exposure. Prescribed fires that are ignited by land managers are considered anthropogenic, and therefore, subject to regulation. Table 61 displays the NAAQS for the six criteria pollutants identified by EPA. Montana's ambient air quality standards (MAAQS) are as stringent as, or more stringent than, the NAAQS. Some of MAAQS have different averaging periods or have been converted from concentration units (ppm) to mass units ($\mu g/m^3$) using different standard conditions. Table 61 also shows the MAAQS (MTDEQ 2015).

Table 60. U.S. EPA National Ambient Air Quality Standards (AAQS) and Montana AAQS

Pollutant	Averaging Period	Federal (NAAQS)	State(MAAQS)	NAAQS Standard Type
Carbon Monoxide	1-Hour	35 ppm [a]	23 ppm [b]	Primary
	8-Hour	9 ppm [a]	9 ppm [b]	Primary
Lead	Quarterly	1.5 $\mu g/m^3$ [c, o]	1.5 $\mu g/m^3$ [c]	NA

Pollutant	Averaging Period	Federal (NAAQS)	State(MAAQS)	NAAQS Standard Type
	Rolling 3-Month	0.15 μg/m^3 [c]	NA	Primary & Secondary
Nitrogen Dioxide	1-Hour	100 ppb [d]	0.30 ppm [b]	Primary
	Annual	53 ppb [e]	0.05 ppm [f]	Primary & Secondary
Ozone	1-Hour	NA [g]	0.07 ppm [b]	Primary & Secondary
	8-Hour	0.075 ppm [h] (2008 std)	NA	Primary & Secondary
Particulate Matter ≤ 10 μm (PM_{10})	24-Hour	150 μg/m^3 [j]	150 μg/m^3 [j]	Primary & Secondary
	Annual	NA	50 μg/m^3 [k]	Primary & Secondary
Particulate Matter ≤ 2.5 μm ($PM_{2.5}$)	24-Hour	35 μg/m^3 [l]	NA	Primary & Secondary
	Annual	12.0 μg/m^3 [m]	NA	Primary
	Annual	15.0 μg/m^3 [m]	NA	Secondary
Sulfur Dioxide	1-Hour	75 ppb [n]	0.50 ppm [p]	Primary
	3-Hour	0.5 ppm [a]	NA	Secondary
	24-Hour	0.14 ppm [a, q]	0.10 ppm [b]	Primary
	Annual	0.030 ppm [e,q]	0.02 ppm [f]	Primary
Visibility	Annual	NA	3 x 10^{-5}/m [f]	NA

[a] Federal violation when exceeded more than once per calendar year.

[b] State violation when exceeded more than once over any 12-consecutive months.

[c] Not to be exceeded (ever) for the averaging time period as described in either state or federal regulation. Pb is a 3-year assessment period for attainment.

[d] Federal violation when 3-year average of the 98th percentile of the daily maximum 1-hr average at each monitoring site exceeds the standard.

[e] Federal violation when the annual arithmetic mean concentration for a calendar year exceeds the standard.

[f] State violation when the arithmetic average over any four consecutive quarters exceeds the standard.

[g] Applies only to NA areas designated before the 8-hour standard was approved in July, 1997. MT has none.

[h] Federal violation when 3-year average of the annual 4th-highest daily max. 8-hour concentration exceeds standard. (effective May 27, 2008)

[i] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm. The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as EPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard. EPA is in the process of reconsidering these standards (set in March 2008).

[j] State and federal violation when more than one expected exceedance per calendar year, averaged over 3-years.

[k] State violation when the 3-year average of the arithmetic means over a calendar year at each monitoring site exceed the standard.

[l] Federal violation when 3-year average of the 98th percentile 24-hour concentrations at each monitoring site exceed the standard.

[m] Federal violation when 3-year average of the annual mean at each monitoring site exceeds the standard.

[n] Federal violation when 3-year average of the 99th percentile of the daily maximum 1-hr average at each monitoring site exceeds the standard. Promulgated June 2, 2010. Expected effective date mid-August, 2010.

[o] The 1978 Pb NAAQS will remain effective until one year after designations are effective for the October 15, 2008, revised Pb NAAQS (0.15 μg/m^3), except in

existing Pb nonattainment areas (East Helena, MT). In East Helena, EPA will retain the 1978 Pb NAAQS until EPA approves attainment and/or maintenance demonstrations for the revised Pb NAAQS.

[p] State violation when exceeded more than eighteen times in any 12 consecutive months.

[q] The 1971 SO NAAQS will remain effective until one year after designations are effective for the June 2, 2010, revised SO NAAQS (75 ppb), except in existing SO nonattainment areas (East Helena, MT). In East Helena, EPA will retain the 1971 SO_2 NAAQS until EPA approves attainment and/or maintenance demonstrations for the revised SO_2 NAAQS.

The federal Clean Air Act (42 USC 85 § 7401 et seq.) requires each state to identify areas that have ambient air quality in violation of the NAAQSs. The status of areas with respect to the NAAQSs is categorized as nonattainment (any area that does not meet an ambient air quality standard, or that is contributing to ambient air quality in a nearby area that does not meet the standard), attainment (meets the national standards), or unclassifiable (cannot be classified based on available information). The unclassified designation includes attainment areas that comply with federal standards, as well as areas that lack monitoring data. Unclassified areas are treated as attainment areas for most regulatory purposes. Areas that have been reclassified from nonattainment to attainment are considered maintenance areas. States are required to develop, adopt, and implement a state implementation plan to achieve, maintain, and enforce the NAAQSs in nonattainment areas. The plans are submitted to, and must be approved by, the EPA. Deadlines for achieving the NAAQSs vary according to the air pollutant at issue and the severity of existing air quality problems. The State of Montana is required to notify the public whenever the NAAQS are exceeded.

Areas of nonattainment are the following:

Montana State PM-10 Nonattainment Areas

- Columbia Falls
- Kalispell
- Whitefish

Montana Federal PM-10 Nonattainment Areas

- Polson
- Ronan

Montana State Carbon Monoxide Nonattainment Areas

- Kalispell

Smoke

The Forest Service participates in an organization known as the Montana-Idaho Airshed Group for prescribed burns within the state of Montana. Group members submit prescribed burns to the smoke management unit for daily, site-specific approval. The smoke management unit is responsible for making sound and timely decisions to maximize the amount of smoke being put in the air (acres burned) and minimizes adverse air quality impacts based on individual airsheds throughout Montana and Idaho. This plan provides some flexibility should a NAAQS violation occur because of smoke. Adherence to the Montana/Idaho Airshed Group Operating Guide (2010) is the current accepted smoke management plan for the state of Montana.

The Forest Service is required to annually obtain an open burning permit from MTDEQ to conduct prescribed burning statewide under the State's Prevention of Significant Deterioration (PSD) program. During the fall burning season (September – December), the smoke management unit coordinates with MTDEQ on burn approvals. During the winter season (December – February), the smoke management unit is not in operation; however, burning can potentially take place with special approval from MTDEQ. Montana DEQ also requires burners to use Best Available Control Technology. Their policy defines Best Available Control Technology as: those techniques and methods of controlling emission of pollutants from an existing or proposed open burning source which limit those emissions to the maximum degree which the MTDEQ determines, on a case-by-case basis, is achievable for that source, taking into account impacts on energy use, the environment, and the economy and any other costs, including the cost to the source.

Air quality is addressed for every prescribed burn in the individual prescribed fire plan. The Forest Service Manual 5140 requires a documented burn plan that contains all of the elements outlined in the 2014 Interagency Prescribed Fire Planning and Implementation Procedures Guide. This guide prompts the burn plan author to address all laws and regulations concerning smoke management as well as the potential for localized nuisance smoke impacts.

In 1998 the EPA released the Interim Air Quality Policy on Wildland and Prescribed Fires (Interim Policy) (USEPA 1998). The document was published with the intent of integrating two public policy goals, "(1) to allow fire to function, as nearly as possible, in its natural role in maintaining healthy wildland ecosystems, and (2) to protect public health and welfare by mitigating the impacts of air pollutant emissions on air quality and visibility." This document recognizes the goal of the National Fire Plan (1995, revised in 2001) to implement fuel reduction projects in the wildland-urban interface and return fire to landscapes, and the impacts this will have on air quality.

Wildfire smoke can produce three of six criteria pollutants the EPA has set maximum standards for to protect human and environmental health. These include carbon monoxide, particulate matter, and volatile organic compounds that can produce ground-level ozone (http://www.epa.gov/air/ozonepollution/). Seventy percent of smoke emissions are made up of small particulate matter (PM2.5 or particulate matter smaller than 2.5 micrometers) which has been proven to cause adverse health effects in humans (http://www.epa.gov/pm/health.html).

Because of this, wildfire smoke from naturally ignited fire and prescribed fire poses a potential health threat to the public. Another smoke emission that poses health risks to humans is carbon monoxide, which can cause short-term health related problems for firefighters. Carbon monoxide rapidly mixes with surrounding air at short distances from a burn area, therefore, poses little to no risk to the general public. Ground-level ozone, although not a direct product of smoke emissions is a concern due to its effect on lung function and plant growth.

The Montana/Idaho Airshed Group (2010) defines impact zones as areas identified as smoke sensitive or with existing air quality problems. Within the affected environment, this includes the Kalispell valley. Impact zones are created for populated areas where air quality concerns to public health arise as NAAQS are sometimes exceeded or close to exceeding. Areas of population generally exist in valley bottoms where mixing and dispersion of air is reduced. Sources of pollution within these impact zones, including smoke, are closely monitored and regulated.

Visibility

The scenic vistas of the nation's national parks and wilderness areas are protected under amendments of the Clean Air Act. There are three classifications (I, II and III) where emissions of particulate matter and sulfur dioxide are to be restricted. The restrictions are most severe in Class I areas and are progressively more lenient in Class II and III areas, with Class III not exceeding the NAAQS. The most stringent protection is required for Federal Class I areas, which include wilderness areas exceeding 500 acres. Congress declared the following as a national visibility goal for these areas:

The prevention of any future, and the remedying of any existing impairment of visibility in mandatory class I Federal areas which impairment results from manmade air pollution. (42 United States Code. § 7491 Section 169A)

The small size of PM2.5 makes these particles highly efficient at scattering light, causing visibility issues, and contributing to what the EPA has called "Regional Haze." Visibility impairment in the form of regional haze obscures the clarity, color, texture, and form of what can be seen. Haze-causing pollutants (mostly fine particles) are directly emitted into the atmosphere or are formed when gases emitted to the air form particles as they are carried downwind. Emissions from manmade and natural sources can spread across long distances and result in regional haze.

The Regional Haze Rule, issued by the EPA in 1999, addresses improving visibility in Class I areas, and The Wilderness Act of 1964 mandates that the Forest Service preserves and protects the natural condition of designated wilderness areas (regardless of Class I designation), including the intrinsic wilderness value of air quality. Regardless of whether smoke violates air quality standards, localized impacts of burning can cause visibility issues on public roadways. Nuisance smoke is defined by the EPA as the amount of smoke in the ambient air that interferes with a right or privilege common to members of the public, including the use or enjoyment of public or private resources (US EPA Interim Air Quality Policy on Wildland and Prescribed Fires 1998). Voluntary smoke management from forest industry, state, and federal partners has helped prevent NAAQS violations and reduced nuisance smoke.

Mandatory Class I Areas within the affected environment include the Bob Marshall Wilderness Area, Scapegoat Wilderness Area, Mission Mountain Wilderness Area, which are managed by the Forest Service, and Glacier National Park, managed by the National Park Service. The Flathead Indian Reservation is a Tribal Class 1 Airshed.

According to Western Regional Air Partnership (WRAP) 2013 the pollutants that contributed to reduced visibility on the worst days for Glacier National Park are primarily sulfates (utility and industrial boilers) and organic carbon (vehicles and other industrial processes), and to a lessor and relatively equal degree, nitrates (vehicles and industrial boilers), elemental carbon (diesel, wood, other combustion) and soil dust.

Visibility for NFS Lands in the ROI is monitored at Glacier National Park, and Monture Guard Station Lolo National Forest Service, via the Interagency Monitoring of Protected Visual Environments (IMPROVE) network.

Climate Change

The EPA defines climate change as major changes in temperature, precipitation, or wind patterns, among other effects, that occur over several decades or longer. These changes may result from naturally occurring events, including changes in the sun's energy or in the Earth's orbit; natural processes within the climate system (such as changes to circulation patterns of oceans); or human activities. The Intergovernmental Panel on Climate Change scientists believe that most of the warming experienced since the 1950s is from human activities resulting in an increase in carbon dioxide and other greenhouse gas (GHG) emissions (EPA 2009).

GHGs are compounds found naturally within the Earth's atmosphere that trap and convert sunlight into infrared heat. Increased levels of GHGs in the atmosphere have been correlated to a greater overall temperature on Earth (global warming). The most common GHGs emitted from natural processes and human activities include carbon dioxide, methane, and nitrous oxide. Carbon dioxide is the primary GHG emitted by human activities in the United States, with the largest source from fossil fuel combustion. Increasing GHGs are associated with changing Earth's climate, resulting in unintended effects to human health and the environment.

There is no requirement as part of the General Conformity Regulations or Council of Environmental Quality (CEQ) NEPA regulations to consider GHG emissions and impacts of proposed actions to climate change, and there is no universal standard or regulation to determine the significance of cumulative impacts from GHG emissions. However in 2010, and again via a revision in 2014, CEQ issued *Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions* for public review and comment. Unlike in 2010, the latest draft applies to land and resource management actions. The guidance emphasizes that agency analyses should be commensurate with projected greenhouse gas emissions and climate impacts, and should employ appropriate quantitative or qualitative analytical methods to ensure useful information is available to inform the public and the decision-making process in distinguishing between alternatives and mitigations. It acknowledges that with regard to biogenic GHG emissions from land management actions such as prescribed burning, timber stand improvements, fuel load reductions, scheduled harvesting, and livestock grazing, that these actions contribute both carbon emissions and carbon sequestration to the global carbon cycle.

In CEQ's example, "…using prescribed fire to maintain natural ecosystem resilience is a human-caused influence on a natural system that both emits GHGs and results in enhanced regrowth and biological sequestration. Notably, the net effect of these agency actions resulting in biogenic emissions may lead to reductions of GHG concentrations through increases in carbon stocks or reduced risks of future emissions. In the forest management context, for example, whether a forest practice is a net carbon sink or source will depend on the climate region (i.e., growth), the rotation length (e.g., southern pine versus old growth), and the human activity (e.g., salvage logging, wood products, bioenergy, etc.)." Additionally, the guidance recommends that agencies consider 25,000 metric tons of carbon dioxide equivalent emissions on an annual basis as a reference point below which a quantitative analysis of greenhouse gas is not recommended unless it is easily accomplished based on available tools and data.

3.9.4 Environmental consequences

Effects common to all alternatives

Smoke from wildfire is anticipated to be the primary source of pollutants and associated impacts to air quality on the Forest, as it has been historically. There is limited ability to alter or control the location or extent of this effect, due to the unpredictable nature of wildfire. Wildfires have the greatest potential to influence short-term air quality and visibility in local areas.

The Forest will continue to adhere to the current accepted state smoke management plan, and obtain required permits and approval from MTDEQ to conduct prescribed burning operations. These controls provide, to the best of our ability, for protection of public health and welfare by mitigating the impacts of air pollution, while still allowing fire to assume its natural role in maintaining healthy wildland ecosystems. .

Alternative A – No Action

The No-Action alternative is the baseline to which the proposed action and alternatives are compared, and current management direction would continue. This section includes a summarization of this direction and an evaluation of effects of continuing that management.

Management direction for alternative 1 – no action

Current plan direction is to coordinate all Forest Service management activities to meet the requirements of the SIP, State Smoke Management Plan [i.e., Montana/Idaho Airshed Group 2010], and Federal air quality standards.

Under the fire management program, direction is to conduct prescribed fire objectives under constraints established by the Montana/Idaho Airshed Group. Air quality is to be maintained at adequate levels as described by State, County, and Federal direction, and all prescribed burns conducted on Flathead National Forest land will be governed by this direction and meet this objective.

The airsheds of the Bob Marshall and the Mission Mountains, are managed (primarily via wilderness fire management plans) to meet Class I Air Quality Standards, and Class II in the Great Bear. The Flathead plan also requires, where manageable or negotiable, identification and mitigation of outside influences, particularly when a PSD action that may impact the wilderness is received from the MTDEQ.

Direct and indirect effects for the no action alternative

Air quality under the no-action alternative would experience continued short and long term effects under current management, both from wildfire and prescribed fire. Continued use of prescribed fire has the potential to influence short-term air quality and visibility in local areas. The current management direction requires meeting air quality standards established by federal and state agencies through requirements of SIPs and smoke management plans. Current direction limits the use of prescribed fire by restricting how much vegetation can be burned and when and where burns can occur. The costs of conducting prescribed fires also increase as a result of burning regulations, which also affects how much vegetation is burned. Limited use of prescribed fire affects the rate and volume of smoke and particulate emissions, which in turn limits impacts to visibility. Table 62 displays the acres of wildfire and prescribed fire for alternative A. Data source for historical information are Forest databases. Future estimates are derived from modeling analysis (refer to appendix 2).

Table 61. Past and projected average acres per decade of wildfire and prescribed fire for alternative A.

Component and Indicator	Historical (average acres per decade)	Future 50 years (average acres per decade)
All wildfire (USFS): acres burned (past 50 years)	132,060	108,900
Prescribed fire (USFS): acres burned (past 23 years)	25,000	0

The modeling did not anticipate any future prescribed burning under alternative A, because there is no explicit objective in the current plan for prescribed burning. However, it is recognized that the Forest burns on average approximately 2500 acres per year under the current plan. To date we have had no NAAQS non-compliance violations. Degradation of visual quality, views, and the aesthetic landscape generally are short-term due to atmospheric conditions which usually are related to accuracy in weather forecasting challenges.

Alternatives B, C, and D

Management Direction for Alternatives B, C, and D

Effects of forest-wide direction, management area direction and geographic area direction for air quality

Air quality under the action alternatives would experience short and long term effects under proposed management. Continued use of prescribed fire has the potential to influence short-term air quality and visibility in local areas. All action alternatives must meet air quality standards established by federal and state agencies through requirements of SIPs and smoke management plans. Use of prescribed fire under the action alternatives would be restricted by how much vegetation can be burned and when and where burns can occur. The limitations for the use of prescribed fire affect the rate and volume of smoke and particulate emissions, which in turn limits impacts to visibility. Table 63 displays the acres of wildfire and prescribed fire for alternatives B, C and D. Data source for historical information are Forest databases. Future estimates are derived from modeling analysis (refer to appendix 2).

Table 62. Past and projected average acres per decade of wildfire and prescribed fire by each action alternative

Component and Indicator	Historical (average acres per decade)	Future 50 years (average acres per decade) Alternative B	Future 50 years (average acres per decade) Alternative C	Future 50 years (average acres per decade) Alternative D
All Wildfire (USFS): acres burned (past 50 years)	132,060	113,660	119,980	112,700
Prescribed Fire (USFS): acres burned (past 23 years)	25,000	49,170	49,100	41,320

The amount of prescribed burning estimated by the model over the next five decades is substantially greater than acres conducted in the past. However, the model is believed to have overestimated the amount of prescribed burning that would be feasible to do (see appendix 2 for more information), and the amount of burning is anticipated to be about the same as it has been in the recent past. Adherence to required regulations is expected to minimize adverse effects to air quality due to prescribed burning, and thus minimize impacts to public health and visibility. As mentioned earlier, wildfire is expected to remain the primary source of smoke and potential degradation of air quality on the Flathead.

Cumulative Effects

Most impacts to air quality and visual quality are related to the contribution of smoke from areas to the south and west of the Forest including all the way to the west coast. Historically, when there are not large fires providing additional smoke to the area, prescribed fires and most wildfires have not produced long-term declines in air or visual quality. Occasionally, smoke from Canada also contributes to air quality issues in the area. Currently, there is no coordination across the border regarding smoke management.

REFER TO volume 2 for the remainder of the chapter 3: Affected Environment and Environmental Consequences. The sections of chapter 3 in volume 2 are:

- Human uses, benefits, and designations of the Forest;
- Production of natural resources; and
- Economic, social and cultural environment.

List of Abbreviations in DEIS

Abbreviation	Spelled out
CFR	Code of Federal Regulations
d.b.h.	diameter at breast height
DC	desired condition (forest plan component)
DCA	demographic connectivity area
FW	forestwide (forest plan component)
GA	geographic area
GBCS	Grizzly Bear Conservation Strategy
GDL	guideline (forest plan component)
GIS	geographic information system
INFISH	Inland Native Fish Strategy
MA	management area
mi	mile
mmbf	million board feet
mmcf	million cubic feet
NCDE	Northern Continental Divide Ecosystem
NFS	National Forest System
NRLMD	Northern Rockies Lynx Management Direction
PCA	primary conservation area
RMZ	riparian management zone
STD	standard (forest plan component)
TMDL	total maximum daily load
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service

Index